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SIXPENNY TELEGRAMS.

THE long-promised scheme for sixpenny telegrams has at length been brought forward, but not exactly in the form anticipated. Most people undoubtedly expected shortly to be able to transmit for sixpence messages certainly more than half as long as those which they are now permitted to send for a shilling, and without any regard to addresses. Therefore when Mr. Shaw-Lefevre made his announcement in the House of Commons last week there was naturally much surprise and disappointment. While sharing the regret of our contemporaries and the nation generally that it has not been found possible to make a simple reduction of one-half in the charge for telegrams, we cannot help admitting that, if statistics such as those urged, based upon experience and extensive enquiry, are to be taken as worth anything, Mr. Shaw-Lefevre has formulated a scheme which goes as far as is possible consistently with safety in the direction of giving—not a reduced rate, but a lower minimum charge. The objections to the proposal to treat the addresses as a portion of the message and to subject them to the same rate of charge, are not altogether without reason, but they are decidedly not unanswerable. The most important is that a propensity would be developed to curtail the description of the person for whom the message is intended to such limits as to make it a matter of some difficulty to the Post Office to secure its proper and speedy delivery; but those who mostly use the telegraph may be depended upon for sufficient shrewdness to avoid any serious blunders in this respect. The cases are rare, we imagine, where the address of the receiver would necessarily exceed five words; and in those instances where greater detail is imperative the sender would surely rather pay an additional penny than risk the safe conveyance of his message. Of course we are assuming that the words constituting numbers in addresses would not be charged for separately; it is the custom in France, we believe, to send five figures, coming together, for the same charge as a single word, and that is a course which might well be adopted here. Various suggestions and possible improvements have, of course, been made, but, so far as we can judge, those which are not open to the same objection as the Postmaster-General's scheme altogether ignore the desirability of avoiding a loss upon the service.

The writer of a lengthy and able article in the *Times* upon this subject asserts that the system of free addresses is not only ruinously expensive to the State, but is also really unfavourable and burdensome to the telegraphing public, and in a lucid manner he adduces facts and arguments in support of this assertion, and of his further contention that the plan under discussion is an equitable one. He points out, too, that the proposed change is not the introduction of a sixpenny telegram simply, but of telegrams varying in price from 6d. through every penny to 1s. The average length of continental inland messages is about 16 words, and, at Mr. Shaw-Lefevre's rate, this means that 8d. will be substituted for a shilling as the customary charge for a telegram. And here we may remark that England stands alone amongst European nations in refraining from imposing a charge for the transmission of addresses. If the system is found to act satisfactorily in other countries, why should it not do so in England?

The compression of the majority of messages within the necessary limits for the sixpenny rate would surely not be a very difficult matter to those to whom the change will have most meaning, and in the few cases where more fulness is necessary the possibility of adding the requisite additional words for an extra penny or twopence only is surely a boon that must greatly be appreciated. A strong fight for the retention of free addresses will no doubt be made before the Bill is allowed to pass, and our counsel to the Postmaster-General in making or receiving any amendments to the points already stated, is to bear in mind the fact that the more liberal he can afford to be the greater likelihood is there of a remunerative increase of business.

ON THE DIRECT MEASUREMENT OF THE AMPERE, OHM AND VOLT.

By J. KESSLER.

THE International Congress of Electricians at Paris, in the year 1881, decided on the choice of electrical standard units in such a manner that their connection with the so-called absolute system of measurement of theoretical mechanics appears insured. The centimetre-gramme-second system was made the foundation of all absolute measurements.

Theoretically speaking the matter appears clearly established. But the question may be raised—How do these units, as theoretically determined, present themselves to the practitioner? How can these units be brought into use in practical apparatus in the simplest possible manner so as to be most widely applied for trustworthy measurements? This we are about to examine in the magnitudes connected by Ohm's law, the ampère, ohm and volt. Which of these magnitudes can be preferably produced in accordance with theory in the most practical manner?

What is the value of the ampère? Theoretically this magnitude is defined as the tenth part of the absolute unit of the electro-magnetic system.

This absolute unit, in connection with the theory of electro-magnetism, can be measured by means of W. Weber's tangent-galvanometer.

Induced by the expression of the Aulic Councillor, Prof. J. Stephan, that the tangent-galvanometer is the ampèremeter *par excellence*, and by Prof. F. Kohlrausch's memoir on the absolute measurement of electric currents by means of the tangent-galvanometer, the author has turned his attention to this method of measuring currents, taking as the basis of his experiments W. Weber's formula for the strength of currents.

$$i = \frac{\mathrm{R\,H}}{2\,\pi\,n}\,\mathrm{tang.}\,\phi.$$

In the memoir above-mentioned there results from this formula a practical definition of the absolute unit of the strength of a current: i is the absolute unit when $\phi = 45°$, $n = 1$, $\frac{\mathrm{R\,H}}{3\,\pi} = 1$, that is when the radius is selected so that its numerical value $R = \frac{2\pi}{H}$ cm. Further $i = \frac{1}{10}$ of the absolute unit or 1 A., when with the same radius in the galvanometer $n = 10$ coils are selected for the angle of deviation of 45°.

For the horizontal components of Vienna in the course of the next four years there follows, on the basis of Kohlrausch's table of the horizontal components of Central Europe on the centimetregramme system, $H = 0{\cdot}208$, so that the radius of a tangent-galvanometer which shows the absolute unit of current strength at the angle of deviation 45° must have the value $R = \frac{2\pi}{H} = 30{\cdot}2$ cm.

This size is certainly not too small for practice, and affords the advantage that a possible error of even 1 mm. in construction involves an error of only 0·3 per cent., and has the convenience of obtaining the value of the ampères in the trigonometrical tangents or in their tenfold value.

The author has had such a galvanometer constructed by the mechanician Kröttlinger, in Vienna, which, with only moderate practice in experimentation, allows of A. measurements between 1 and 30 never faulty to the extent of 1 per cent., which is fully sufficient for practical purposes.

The results of several hundred measurements are collated in a table and have been published in Part IX. of the Vienna *Elektrotech. Zeitschrift* for 1884.

Since then the author has worked with tangent-galvanometers wrapped with 2, 8, 10, 100, 250, 350 and 500 coils, and can maintain, on the faith of some thousand experiments, that with reference to the many practical hints which Prof. Kohlrausch has given in his guide to practical physics (Leitfaden der Praktischen Physik), the multiplying power of the number of coils may be pronounced decidedly exact.

For large numbers of coils—from 100 upwards—the thickness of the wire must be small with reference to corrections for the section of the coils, so that the corresponding correction in the formula for the current strength may vanish, thereby rendering the resistance of the galvanometer a considerable magnitude.

It is convenient in a tangent-galvanometer of 100 coils to obtain the strength of current of 0·1 A. at a deviation of 45°, so that the limits of good measurement lie between 0·01 A. and 0·3 A., but the resistance for this number of coils of a wire of 0·4 mm. exceeds 25 Ω, a magnitude which cannot be neglected against battery resistances. Certainly for the measurement of telegraph currents such a high number of coils, with a moderate resistance, appears sufficient.

The sensitiveness can be doubled, and the resistance simultaneously halved, if the radius is made only half the size.

For practical purposes it is useful to have the reduction-factor of the tangent-galvanometer, if possible, a power of 10, so that the current strength may be obtained from the table of trigonometric tangents (which are given in various tables of logarithms, and, amongst others, in the Electro-technical Calendar), simply by the trigonometric numbers, or by the displacement of the decimal point in them.

If practitioners desire still greater convenience, and to have a direct graduation in ampères introduced in the galvanometer, such a graduation has been included in the Part IX. of the Vienna *Elektrotech. Zeitschrift*, above referred to.

Weber's galvanometer, however, with the radius given $R = \frac{2\pi}{H}$ has the defect that in cases where the results are to be accurate to at least 1 per cent., the radius must be selected differently for different places, or even for the same place at different times, or else a correction must be added to the approximate reduction-factor, 1. Besides, the radius or the diameter of 60 cm. is large.

These inconveniences may be easily remedied if the needle is made capable of displacement from the centre of the coil-circuit normally towards the plane of the coils. Then Weber's formula no longer applies, but the following more complicated expression :

$$i = \frac{(R^2 + X^2)^{\frac{3}{2}}}{C^2 R^2 \pi} \, T \text{ tang } a \left[1 + \tfrac{3}{2} (R^2 - 4 X^2) \frac{l^2 \sin^2 a}{(R^2 + X^2)^2}\right]$$

where $R = AM$, the radius of the coils $X = OM$ the distance of the needle from the centre of the coils.

T is the value of the horizontal component of terrestrial magnetism.

The constant, C, becomes 1 if the centimetre-gramme system is taken as a basis.

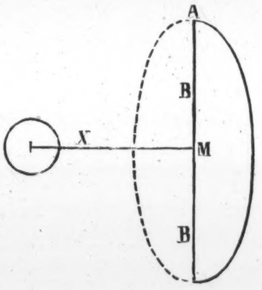
For n coils, n is introduced into the denominator, for R the mean radius, and for the section of the coils a correction obtained by putting instead of

$$\frac{r\,T}{2\,n\,\pi}$$

$$\frac{r\,T}{2\,n\,\pi}\left(1 + \tfrac{1}{8}\frac{b}{r^2} - \tfrac{1}{12}\frac{n^2}{r^2}\right)^4$$

where b is the breadth and h the height or thickness of the layers of the coils.

For the practical measurement of a current it would be exceedingly inconvenient if this complicated formula had to be calculated out in all determinations. As it is generally quite sufficient in practice to be accurate to fractions of a per cent., the author was led to inquire if it was not possible to have the entire constant factor equal to unity in the tangents of the angle of deviation, and still to obtain results accurate at least to $\frac{1}{2}$ per cent. This is quite possible. It requires merely a certain selection of the radius and a certain distance of the needle from the centre of the coils.



It is most convenient according to Gaugain to select the distance of the centre of the circle from the centre of the needle equal to the half radius, whereby the formula for the current strength, i, takes the simple form : $i = \frac{5\sqrt{5}}{16\pi}$ R T tang X absolute current units.

The constant factor $\frac{5\sqrt{5}}{16\pi} = 0{\cdot}222426$, so that the formula for the strength of current measured on a tangent galvanometer on Gaugain's principle takes the form: $i = 0{\cdot}222426$ R T tang ϕ absolute current current-units.

For n coils, in ampères we have $i = \frac{0{\cdot}222426}{n}$ R T tang. $a \times 10$ A.

The author uses this formula in the construction of apparatus for measuring currents in which the radius is selected so that the constant factor amounts to the unit $\frac{1}{10}$, $\frac{1}{50}$, and $\frac{1}{500}$, *i.e.*, that at the angle of 45° there is indicated the current-strength of 1 A 0·1, 0·02, 0·002 A. In order to obtain the current of 1 A at the angle of deflection of 45°, the magnitude of the horizontal component for a given place is required. At Vienna for the years 1884-88 this amounts to 0·208 centimetre-gramme or respectively dyne.

If in the last formula we put for i

$$T = 0{\cdot}208, \; n = 10$$

$$i = \frac{0{\cdot}222426}{10} \, R \cdot 0{\cdot}208 \cdot 10.$$

tang a, R must be put $= 21{\cdot}62$ in order that the factor 1 may be constant to 0·1 per cent. With a radius of half the size $r = 10{\cdot}8$ cm. the same end is reached with half the number of coils, $n = 5$.

Both these constructions were made for the author by the mechanician F. Kröttlinger, in Vienna, and about 1,500 experiments were made as is shown below in a tabular form.

If 500 coils are taken in the galvanometer with the radius $r = 10{\cdot}81$ cm. we obtain for an angle of deviation of 45°

$$i = 0{\cdot}01 \text{ A}$$

With so great a number of coils the diameter of the wire must be very small on account of the correction for the section of the coils, if this correction-clause

$$\left(1 + \tfrac{1}{8}\frac{b^2}{r^2} - \tfrac{1}{12}\frac{h^2}{r^2}\right)$$

is to vanish down to 0·1 per cent.

In the apparatus the thickness of the wire has been so selected that the length of the section of all the coils, is 1·5 cm., and its breadth does not exceed the same value. So thin a wire represents, however, a resistance of several hundred ohms, a magnitude which is very great in comparison with the resistance of machines and batteries.

This very circumstance permits on an accurate measurement of the resistance of a determination of the electromotive force in volts. In order here also to avoid computations troublesome for the practical man an additional resistance is joined to the resistance—accurately determined—of the coils of the galvanometer wire so as to make up a total resistance of 1,000 legal ohms = 1,060 Siemens units. The measurements here pertaining have been made by the author in the laboratory of the Imperial Military Academy at Vienna with a mirror-galvanometer and an excellently constructed resistance box with a bridge by Siemens and Halske of Berlin.

The potential at the clamps of the galvanometer amounts according to Ohm's law to

$$\text{E} = \text{J} \times \text{W}$$

for an angle of deflection of 45° on a galvanometer with such a radius that the current strength 0·01 A is indicated for 500 coils, on account of the resistance of 1,000 Ω

$$\text{E} = 0{\cdot}01 \times 1000 = 10 \text{ V}.$$

If there is now selected a second accessory resistance of 9,000 Ω, and consequently a total resistance of 10,000 Ω we have at the deviation of 45° exactly the E.M.F. of 100 V., so that in this manner the measurement of 1 V. up to 300 V. can be effected with an accuracy which can be easily carried to 0·1 per cent. With this choice of resistances the trigonometric tangents of the angles of deflection or their multiples by 10 give the value of the E.M.F. in volts with exactly the same graduation as indicated above.

The construction of the tangent galvanometer is thus described by the mechanician F. Kröttlinger of Vienna.

Upon a brass tripod with set screws there rises a brass pillar 14 cm. in height, capable of rotation in a conical hole bored in the tripod. Upon this is fixed the galvanometer case which is cast along with it. The graduation of the circle is nearly 10 cm. in diameter.

Over the scale there plays a rhomboidal magnetic needle, 23 mm. in length, and carrying a thin black finger, 92 mm. in length, fixed at right angles to the magnetic axis. The needle itself is suspended by a cocoon thread so that its sensitiveness is very great. The brass pillar above mentioned has two perforations for the reception of two brass bolts 9 cm. in length, which connect with the pillar a wooden ring of many pieces glued together and containing the coils of copper wire. This method of fixing renders it possible to displace the ring within a space of 8 cm., so that all the horizontal components of central and western Europe can be taken into account with this apparatus.

The ring itself contains a nut, accurately calculated to receive the wires which are coiled in such a manner that there come first 250 turns of very fine wire, then five turns of a thick wire for measuring ampères, and then again 250 turns of thin wire.

The mean radius has the magnitude stated in the calculations quoted. Both the thick and the thin wires are carried to special clamps, which may be known as ampère and volt clamps. The current of 1 A., on passing through the five turns of thick wire, gives a deviation of 45°. By means of these coils currents of from 0·1 to 3 ampères can be very conveniently measured.

In order to extend the limit for strong currents a by-circuit of strong copper slips, arranged in a bifilar manner, is placed so that it may be introduced by means of a plug.

The resistance of this by-circuit is so arranged that when it is introduced only $\frac{1}{10}$th of the entire current passes through the five galvanometer coils. In this manner there can be measured currents from 1 to 30 A., which will be sufficient for most of the requirements of practice.

The above apparatus, after being repeatedly compared with other apparatus and after many measurements of its dimensions, is found to have a radius of 10·77 cm. On comparison with the copper voltameter it is constructed to within 0·1 per cent. for the horizontal component on Gaugain's principle. It permits of measurements with such accuracy that the mean error between 30° and 70° certainly does not reach ¼ per cent. This conclusion is based upon 215 experiments, in each of which the index was read off four times, the error of observation never amounting to 0·10 per cent. As a check, the current measured was sent through a galvanometer of double the size—radius = 21·52—and the 215 experiments were thus repeated, the index being read off four times in each. Both stood on wooden shelves 3 metres apart from each other, so that they were secured from shaking, and could not perceptibly act upon each other. The connecting wires were parallel and were worked together to form one cable. For strong currents up to 20 A. there was used a wire of 2·7 mm. in thickness, and for volts with a feeble current a wire of 0·7 mm. (See table).

With the above described apparatus the author has executed about 500 measurements of currents, and publishes the results in the appended table. With the exception of those marked with an asterisk they have been conducted in such a manner that a second tangent galvanometer of nearly double the size of the first received the same current as a check. Both galvanometers were at the respective distance of 3 metres, so that they could exert no measurable influence upon each other. The results of all these experiments showed in determining volts scarcely 0·1 per cent. difference between the indications of the two galvanometers. Thence follows also the equality of the horizontal components in the place of observation, which may be explained from the circumstance that there exist but few large masses of iron in and near the building. The same equality was observed when the galvanometers were made to change places. This (with regard to the circumstance that the copper voltameter which received for 201 minutes a current of the mean strength of 1·14149 A. and gave a precipitate of 5·62 grms. copper) justifies the conclusion that, on the basis of 1·1808 grms. copper for an ampère hour, the horizontal component of the place of observation has the value of 0·209 dynes, consequently ¼ per cent. more than the value corresponding to Lamont's data, which has been adopted in Kohlrausch's "Practical Physics." In practice this difference is unimportant as accuracy of 1 per cent. is rarely needed. In the measurements above cited the mutability of the horizontal component even in the same locality had to be taken into account in order to obtain, as far as possible, an accuracy of 0·1 per cent.

In order to be adapted for all the possible horizontal components of Europe with the same apparatus without losing the convenient reduction factor 1, 0·1, 0·01, it is merely necessary, according to the initial formula for the measurement of currents, to approximate the magnetic needle to the ring, or in case of smaller horizontal components, to withdraw it. For this purpose we make use of the simple rule for the apparatus above described, constructed on Gaugain's principle for the horizontal component 0·209, that a displacement of the ring of a little more than 1 mm. corresponds to a change of 1 per cent. in the horizontal component which occurs normally in eight years.

The maximum of the horizontal component in Central Europe, 0·225, amounts to a maximum displacement of 1 cm. At Königsburg the ring must, *e.g.*, be moved about 1 cm. nearer to the galvanometer, whilst in Scotland it must be withdrawn by about 2 cm., as the horizontal component is about 0·170.

Hence it appears that an instrument constructed at Vienna on Gaugain's principle can be easily so adjusted for all the horizontal components of Europe, that the factor for reduction to ampères is a power of 10. For guidance, the following table may be useful :—

If the distance of the ring from the needle and the 8 cm. tie-bolts for Vienna on Gaugain's principle with a radius of 10·77 cm. is *e* = 5·38 cm., then we have for the following towns :

Buda-Pest	*e* ...	5·8 cm.
Brünn	*e* ...	5·7 „
Berlin	*e* ...	6·5 „
Munich	*e* ...	5·6 „
Paris	*e* ...	6·0 „
London	*e* ...	7·0 „

These statements are at least satisfactory for measurements which are to be accurate to within 1 per cent. They show, further, that the influence of the horizontal component of terrestrial magnetism upon practical measurements can be easily taken into account, and easily admits of corrections in the apparatus in order to simplify the calculations. It is merely necessary to ease the screw in both tie-bolts, to place the ring and to tighten the screws again.

As it may be seen from the figures in the table marked with an asterisk, the tangent-galvanometer described allows of a very simple measurement of volts and ampères. The trigonometric tangents of the angles of deflection give the value of the ampères and of the volts by a mere displacement of the decimal point. The apparatus, moreover, is constructed according to the theory of electro-magnetism, and hence it does not require standardising, and can even serve for standardising other apparatus. In any case it is admirably adapted for studying the peculiar fluctuations of the various sources of currents.

Of these sources a well-charged Daniell is undoubtedly the most trustworthy, as appears from an examination of the figures in the table, in which there appears a very interesting picture of the fluctuations of the electromotive force and of the resistance. It is plainly to be seen how, with a strong current, the electromotive force decreases, and how, in the course of 137 hours, the force varies. This apparatus commends itself for the study of so-called normal elements on account of the expedition of the calculations.

As the correction for the horizontal component of terrestrial magnetism is easily practicable at very distant points of the earth's surface, and for many years, so as to admit of the advantage of the factor for reduction, various objections against the practical applicability of the tangent-galvanometer disappear.

As regards the periodicity of the oscillations it is very possible to effect a quick stoppage of the needle. For instance, a Pohl's commutator may be introduced, the needle allowed to vibrate, and contact made in the moment of the greatest opposite amplitude. The author has thus often effected complete aperiodicity. The limits of a measurement to the fractions of a per cent. can be easily adapted to all practical requirements by suitable by-circuits and resistances.

The measurement of the ohm follows in accordance with Ohm's law, and is especially accurate for high resistances, *i.e.*, from 100 to 1,000 Ω. The measurement of resistance is effected after the determination of the intensity in ampères, and of the potential in volts according to Ohm's law by the division :

$$\text{Resistance} = \frac{\text{electromotive force}}{\text{strength of current.}}$$

The case is especially pre-supposed that the measurement is effected as follows. After the strength of the current in a battery or an electrical machine has been determined by introducing as above the five turns of the galvanometer into the entire current—of an intensity from 0·1 to 30 A.—we proceed to the measurement of the volts.

Whilst the source of the current is performing any work, the conduction from the volt clamps at its poles is arranged so that a part of the current may pass through the 500 turns of thin wire and thereby give a measurement of the utilisable potential. This introduction involves the smallest loss of current-power, since in the measurement of many ampères the resistance of the galvanometer scarcely reaches 0·02 ohm, and even if the total resistance is 5 ohms, the loss of the current is not quite $\frac{1}{2}$ per cent. In the measurement of the volts described, we find on account of the ramification of the current

$$i = i_1 + i_2.$$

Here i denotes the total power of the current, i_1 the power utilised, i_2 the power measured.

TABLE OF MEASUREMENTS OF CURRENTS IN AMPERES, LEGAL VOLTS AND OHMS ON THREE GALVANOMETERS.

Ia. 500 turns of thin wire with a mean radius of 10·77 cm. ... ...
Ib. 5 turns of thick wire with the same radius of 10·77 cm. ... ...
II. 500 turns of thin wire with a mean radius of 21·52 cm. ... ...
On Gaugain's principle.
III. 1 turn of wire 7 mm. thick ; radius 30·2 cm., needle in centre of coil.

Number of galvanometer.	Angle of deflection.	Tangent of angle of deflection.	Ampères.	Volts.	Ohms.	Remarks.
I a	34·7°	0·6920	0·006920	6·920	1000	Tension at clamps of galvanometer Ia alone.
I a	33·0°	0·6494	0·006494	6·922	1066 total resistance	Temperature 17° C.
II	18·0°	0·3249	0·006498	6·925		
I a	18·5°	0·3349	0·003346	6·892	2066 total resistance	The same current was passed through two galvanometers.
II	9·5°	0·1674	0·003348	6·894		
I a	17·9°	0·3230	0·003230	6·886	2133 total resistance	
II	9·2°	0·1620	0·003240	6·897		
I b	22·5°	0·4142	4·142	—	Battery resistance about 1·5	
III	22·5°	0·4142	4·142	—		The current was passed at I b through a strong by-circuit.
I b	24·35°	0·4520	4·520	6·17	1·36 total resistance	
III	24·40°	0·4536	4·536			
I b	10·4°	0·1835	1·835		3·66	
III	10·4°					
1 b	61·4°	1·834	1·834	—	3·35	Without by-circuit.
*I a	44·55°	0·9814	0·009814	9·814	1000	Tension at clamps of I a.
I a	42·65°	0·9281	0·009281	9·850	1067 total resistance	
II	24·8°	0·4620	0·009240	9·858		The same current passed through two galvanometers.
I a	24·8°	0·4620	0·004620	9·853	2133 total resistance	
II	13·0°	0·2309	0·004618	9·850		
I a	16·97°	0·3051	0·003051	9·763	3200 total resistance	
II	8·68°	0·1526	0·003052	9·776		
I a	16·87°	0·3032	0·003032	9·702	3200 total resistance	
II	8·60°	0·1512	0·003024	9·677		
*I b	54·75°	1·4149	1·4149	—	—	Mean current strength for 201 minutes by the copper voltameter.
*I a	26·90°	0·5075	0·005075	5·075	1000	Tension at clamps I a.
I b	31·0°	0·6009	6·009	—	Battery resistance not quite 1 ohm	I b with by-circuit.
III						
*I a	41·33°	0·8796	0·008796	8·796	1000	Tension at galvanometer 1 a.
I b	27·0°	0·5095	5·095	8·818	1·75	By-circuit at I b.
III						
I b	9·85°	0·1736	1·736		5·08	
III						
*I b	60·0°	1·732	1·732	8·798	5·08	No by-circuit.

By way of example, let $i = 10$ A. There passes through the galvanometer wire of 500 turns, even with a utilised potential of 100 volts, a current of 0·01 A., so that the current-power utilised $i_1 = i - i_2 - 10 - 0·01$ A., indicating a loss of current of 0·1 per cent.

To determine the very considerable fluctuation of the battery-resistance, it is simplest to make use of Ohm's method. The current of the battery is first measured alone; it is $i_1 = \frac{E}{W}$. A known resistance is then introduced, preferably nearly equal to the resistance of the battery. It may here be assumed with sufficient accuracy that with this the entire electromotive force of the circuit can be determined as above on the basis of the measurement of the tension at the clamps. Elements with large plates give good results in this respect, as their liquids do not so soon become mixed and modified.

For measuring resistances exceeding 100 ohms, the galvanometer with 500 coils is very suitable, as the elements remain quite constant for hours with a feeble current.

On measuring the resistance of six to nine Daniells with large plates on Ohm's method with a thin wire, there was found as the mean of eight experiments, a resistance of 507 ohms at 17° C, whilst on measurement with the mirror galvanometer and bridge at the same temperature, the mean was 506·8 ohms—a satisfactory result.

In the first 14 experiments the source of the current was six Daniell's elements, arranged in series, 21 cm. in height, 12 cm. in diameter, the liquid in contact with the zinc was dilute sulphuric acid at 10 per cent., and that in contact with the copper a very concentrated solution of sulphate of copper. The copper retained a fine light red surface of copper during the entire experiment.

In the next 10 experiments there were employed nine Daniells arranged as above. The first six of them had been put together for 24 hours previously.

In the next two experiments were used three Bunsen elements, charged with dilute sulphuric acid and with nitric acid, which had been repeatedly used before.

In the last four experiments five Bunsens were used arranged in series like the three former ones. Size the same as the Daniell's.—*Central Blatt für Elektrotechnik.*

A NEW ASTATIC GALVANOMETER.*

By C. L. R. E. MENGER.

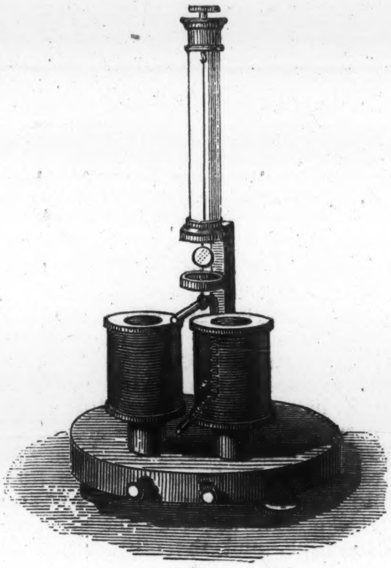
BY combining the arrangement of the galvanometer here figured, I purposed obtaining an instrument of a simple and convenient construction with a sensitiveness sufficiently great to serve in experiments which demand reduction to zero (as for Wheatstone's bridge), and this with an exactitude at least equal to that obtained in ordinary laboratory experiments.

Under these conditions it seemed to me that an astatic arrangement is far preferable to an ordinary needle rendered astatic by means of a permanent magnet of an action opposite to that of the earth (Hany's magnet). This latter arrangement, often preferred by reason of the simplification of the galvanometer, is excellent when we wish to surround ourselves with all the necessary precautions in a special laboratory. It is nevertheless clear that surrounding causes of perturbation will have a very strong action on such a needle, whilst an astatic combination is much less influenced.

The construction of an astatic arrangement presents certain difficulties, and variations in the magnets often disarrange the apparatus.

To avoid this inconvenience, the idea struck me to employ merely a single magnet, so arranged as to form in itself an astatic combination, which I have effected with a magnet curved thus [, and suspended as indicated in the figure, so that the two poles are vertically one above the other. The position of the two poles in a vertical line has also been employed by Messrs. T. and A. Gray. The arrangement adopted by these gentlemen was not known to me last year, when I had my apparatus constructed, which differs from theirs also by the simplicity of the form, by the suspension, and the arrangement of the coils. As a notable part of the length of the magnet is very near and parallel to the axis of rotation, there results a moment of inertia, which is relatively feeble, regard being had to the force of the magnet.

The regulation of the astatic arrangement is very simple, and is effected by causing the magnet to slide more or less in the stirrup which supports it.



The magnet is influenced by two vertical bobbins which act laterally. This arrangement certainly does not give an attraction of the magnetic pole as strong as the axial attraction in M. J. Rosenthal's arrangement. The action is, nevertheless, very sufficient, as will be seen, and is stronger than it would be believed, perhaps, because the coils act by both ends. The construction is very simple and symmetrical as regards the position of equilibrium of the magnet, the deviations of which are consequently exactly equal on both sides.

It is easy to remove the coils and to substitute for them others suitable to the experiment in view. I intend to construct an apparatus in which three pairs of different coils will be placed on a plate movable on an axle concentric with the axis of suspension of the needle, so that we may place opposite the magnet the pair which is most suitable during the experiment itself.

The inconvenience of the use of several coils, pointed out by M. Rosenthal, exists only when the replacement presents some difficulties. It is otherwise certain that we must always obtain the best results by making use of coils appropriate to each case.

As to the sensitiveness of my galvanometer, I repeat that I did not demand extraordinary results. It is certain that by constructing my apparatus in a more careful manner we should obtain a much greater sensitiveness. Such as it is, the apparatus gives results far surpassing those obtained with other instruments constructed for an analogous use.

I have compared my instrument with the Universal galvanometer of Siemens, an instrument very well constructed, and with an especial reference to the use of different methods of reference to zero; it has a resistance of 100 Siemens units; my apparatus has only 0·5 Siemens unit. Notwithstanding this great difference in the resistances, I still obtain a deviation which reaches half that of the Universal galvanometer when the apparatus are traversed by the same current. With an equal resistance my apparatus, therefore, will be far more sensitive.

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* *La Lumière Electrique.*

I must still point out that the deviations of the magnet of my apparatus are indicated by a graduated dial-plate, as in the Universal galvanometer. The better to show the arrangement of the magnet and the coils, I have supposed in the figure an instrument constructed to read the deviations by means of a mirror and a divided scale, a disposition which must evidently be employed if we wish to obtain great sensitiveness.

ELECTRIC LIGHT ON BOARD THE SS. "UMBRIA" AND "ETRURIA."

MESSRS. J. D. F. ANDREWS & CO., Woodside Electric Works, Glasgow, have just completed, on board the ss. *Etruria*, the last of two installations which in their proportions surpass anything that has hitherto been attempted in the application of electric light to steamships.

In the *Umbria* and *Etruria* the installations consist of about 850 lights each; and we append a description of one of the installations, which will, we have no doubt, be interesting to our readers. (The description applies to both installations.)

The space allotted to the electric machinery is unusually large, measuring 32 ft. by 14 ft., and is situated on the lower deck midships forward of the engine room. Here are placed four Brotherhood engines, two abreast, back to back, three having cylinders 8 in. diameter by 6 in. stroke, and the other 6 in. diameter by 4½ in. stroke. The small engine drives a Siemens 200-light machine, and the other three a 350-light dynamo each. Swan glow lamps are used, and of these ninety are distributed in the engine room, stoke-holes, &c. The wires conveying the current to these lamps are covered with India rubber and a special composition for resisting sea water, and they are sheathed over all with iron wire, as a substitute for the tube generally used in engine rooms and such places.

The joints between the branch and main wires are protected by a small ⊤-shaped joint-box. Each lamp in the engine-room, as also in every other part of the ship, is fitted with a very simple switch. It consists of a screw severing connection to the lamp from the ship, which is used as a return. A fusible connection is also attached to each lamp. The engine room lights are divided into two circuits, each with a separate switch; and each stoke-hole is also on a separate circuit.

The dynamos are connected to the main switch-board on the bulk-head close to the engines. To this switch-board also are brought the six main circuits that supply the ship.

The switch-board consists of an iron box about 4 in. deep, with its opening against the bulk-head. In the face of the box are four rows of six holes, each 2 in. in diameter, radiating from the centre, and the box is half filled with a board of teakwood with corresponding holes. In each of the holes in the teakwood are fixed copper springs, one on each side of the hole; one spring of each hole of a row is connected to a brass strip in communication with one of the machines, the other spring being joined to a circuit of lights in the ship. A brass knob with a stem, and an insulated ring at the end of the stem is pushed into one of these holes when the machine is to be connected with one of the circuits. The corresponding holes in each circle are joined together, so that by removing the plug from the hole in one position of the row, and placing it in the corresponding hole in another, the circuit will be joined to another machine. The circuits are numbered, starting from the stern of the ship, the first circuit supplying the night system, in which are about 200 lights, including those in the engine room and stoke-holes. No. 2 circuit lights the after portion of the ship. No. 3 lights midships. Nos. 4 and 5 supply the saloon, ladies' saloon, music room, &c. No. 6 supplies all lights forward of the saloon. Each of these main leads is carried to a group of switches at the junction of the main branch leads, where there is also a fusible connection. Each of these switches controls a group of about thirty lights, and they are placed in boxes recessed in any convenient places; in passages, generally, and at the foot of stairs. The switches are constructed of a brass box, and on a similar arrangement to that described as being used as the main switch-board, except that the plug cannot be entirely withdrawn. In appearance this switch resembles the ordinary steam wheel valve. The main branch fusible connection which protects the wires is a small circular block of wood with a groove across it, in which is laid a piece of lead wire, No. 16 B.W.G., connected at each end to a screw which projects at diametrically opposite sides of the block. The switch and fusible wire are connected together by a loop of wire. The small branch wires lead to the lamps direct, without the intervention of other fusible connections; but in the back-block of the lamps there is a piece of No. 20 lead wire which protects the lamps, and also in the event of a defect, shows in which lamp it is.

In addition to the switch inside the room or in the lamp, there is also a switch of the same kind placed in the return wire in the passage, one for each state room. This firm has been the first to introduce switches in the return wire.

The holder is also of new design, although the same as used by this company in the installation on the *Ems*, and various other installations. It consists of four spring prongs formed from a brass tube; two of these grip the neck of the lamp, which is made of plaster of Paris, knob-shaped, to suit them. The other two have saucer-shaped ends, and press on brass contacts held in the plaster. As will be understood, one of the prongs is insulated from the rest by a small piece of wood forming the body of the holder, the insulated prong being attached to a pin passing through the centre of the wood. The holder is screwed on to the nozzle or nipple of the electric bracket, and in screwing it, the pin holding the insulated prong meets with the wire projected from the end of the nipple, thus making contact with the central wire fitting.

Altogether 103 lights are used in the lighting of the main dining saloon, 84 of which are suspended over the tables in 3-light electroliers, hanging about 2 feet 6 inches from the ceiling. The remainder of the lamps are in small brackets and pendants, so as to give light over the side seats. The lighting of the saloon is very effective.

Above the saloon is the music room, having 17 lights round the walls and over the piano and organ. The smoking room has also 17 lamps. The remainder of the lamps are distributed about the ship, 172 being in the state rooms. All the fittings are silver-plated, with the exception of those in the galleys, seamen's quarters and engine room.

On the upper deck, just outside the engine room, is a cast-iron box containing two switches and connecting terminals for the Andrews arc lamps. These lamps are of the same design and construction as those adapted to a masthead light on board the North German Lloyd Company's ss. *Ems* and *Eider*.

The lamp is of great simplicity, and is well suited for the use of those not well conversant with electrical matters. In this case the lamp is arranged with double carbons.

These installations have been carried out in all their details under the personal supervision of Mr. Andrews, who also worked out the various fittings here described.

Everything connected with the installations (including the silver plating) has been manufactured by the firm at their works with the exception of the dynamo machines, Swan lamps and engines.

THE TELEPHONE AT LONG DISTANCES.

IF we had been told only a few seasons ago that in the year of grace, 1885, we should be able to carry on conversations along a wire not merely between two distant points of one and the same city, but between two cities and even between two countries, we should have shrugged our shoulders and accused such pretensions of folly.

Yet this pretension has been realised ; and although all attempts hitherto made to utilise the telegraph wires for the transmission of speech to a distance seemed to remain in the stage of interesting experiments without any practical utility, our learned countryman, M. Van Rysselberghe, has had the good fortune to find the solution of this important problem.

It is not without some national pride, says *La Chronique des Travaux Publics*, that we have seen this prodigious invention inaugurated between Brussels and Antwerp, *i.e.*, exactly at the same place where, 38 years ago, on September 9th, 1846, the first telegraphic line on the continent was opened to the public.

Thanks to the active and devoted assistance of the staff of the administration of telegraphs, and thanks, also, to the speed with which the apparatus has been supplied by the constructors who are at the same time the licencees under Van Rysselberghe's patents, the Belgian public can already correspond between Brussels and Antwerp, Brussels and Ghent, and Liege and Verviers. In a few weeks all the principal centres of Belgium will be able to correspond telephonically among themselves along the telegraph wires, and it will be the same without delay between Antwerp and Rotterdam, as well as between Brussels and Paris, Madrid and Lisbon.

Van Rysselberghe, who is at present installing his system in Spain, has just seen it officially inaugurated between Madrid and Burgos, over a length of more than 250 kilometres.

It is known already that applications of the same system have been successfully made in Portugal, France, Holland and America, and all other countries will not hesitate to follow the example thus set.

The proof lies in the fact that everywhere, in England, in Germany, and even in France, there is a demand for the construction of special lines for the interurban telephonic service.

But this is precisely what was the case in Belgium before the Van Rysselberghe system was known. It may not be useless to remember that when a demand of credit was addressed to the Chamber of Representatives for the construction of 600 kilometres of telephonic lines, the Central Section, through its reporter, M. Callier, proposed to apply the Van Rysselberghe system to all our telegraphic lines.

"The expense of this appropriation," said M. Callier, "is estimated at 150,000 francs. The cost of an equivalent net, if specially constructed for the telephone, would have been three millions."

We add that it would have involved, further, an annual outlay of 300,000 francs for maintenance, this being generally estimated at 10 per cent. on the first cost of the net of lines.

These considerations induced the Minister of Public Works to approve, December 14th, 1883, the convention by which Messsrs. Mourlon undertook to furnish at an early date all the materials necessary for the appropriation of the 30,000 kilometres of wires of which our telegraphic net consists.

We know how the initiative of our Government has been crowned with success, and we are surprised that at the moment when the French Government is making experiments with the Van Rysselberghe system, which succeed perfectly, certain journals, such as *La Lumière Electrique* and the *Bulletin International des Telephones*, complain of it to Minister Cochery, and recommend to him the construction of special lines, the cost of which we have just seen.

We regret to mention that these same organs have confined themselves, in defending their view, to denying the results obtained by Van Rysselberghe's system between Rouen and Havre, results unanimously proclaimed not only in the press of Rouen, but in the principal Paris journals, including the *Figaro*, and in letters published by Raymond, the chief engineer who directed all the installations.

Further, *La Lumière Electrique*, whose editor, M. Cornelius Herz, cannot console himself, doubtless over having lost an important law suit against Van Rysselberghe, has thought well to profit by the latter being compelled, on account of his journey to Spain, to suspend for the moment his negotiations with Cochery, by announcing that these were broken off, though the correspondence exchanged on this occasion proved the contrary.

Finally, the *Bulletin International des Telephones*, in its last issue, reproaches the Van Rysselberghe system with having attracted lightning, though there appears to have been merely a high wind which overturned the telegraph posts. However this may be, if the editor of that journal had taken the opportunity to see or even to read the description of Van Rysselberghe's apparatus, he would have been convinced that these, being each fitted with a lightning rod devised by the same inventor, cannot be responsible for the facts mentioned.

Decidedly if Van Rysselberghe's system encounters no more serious obstacles than those just mentioned, we have no fears concerning its success.

ON THE CONSUMPTION OF ZINC IN OXIDE OF COPPER BATTERIES.

By F. DE LALANDE AND G. CHAPERON.

THE consumption of zinc in an electric battery is one of the most important elements of the outlay which the current involves ; the absence of internal work with an open circuit, consuming materials uselessly, is therefore an essential condition for a permanent battery intended to act for any length of time.

The oxide of copper battery, which we have previously described in this journal, is one of those which possess this important property. Local actions are suppressed when the circuit is open, and materials are consumed only in proportion to the work done. This fact, established by a tolerably long experience, and affirmed, in consequence of precise experiments by various distinguished observers, may seem in contradiction with the experiments, the results of which have been published by Dr. Van der Ven if these measures must definitively receive the interpretation which is ascribed to them by the eminent physicist of Harlem.

Without in the least contesting these measurements let us examine as briefly as possible the circumstances under which they have been made, and which, unfortunately, have not been defined in a sufficient manner.

Dr. Van der Ven cites at first a preliminary experiment in which a plate of zinc, exposed for seven days to the action of a solution of potassa at 30 per cent., has lost a notable part of its weight ; but he does not say if the solution of the zinc was effected with or without the evolution of hydrogen : two cases may have occurred.

1. If the amalgamated zinc has been attacked with an escape of hydrogen this is certainly due to a very simple reason—the bad quality of the metal. Our censor does not seem to have experimented with zincs of different qualities, which would have been very useful. From the fact that a special sample of zinc has been attacked we cannot infer in a general manner that zinc is dissolved by potassa. Everyone knows, in fact, that the quality of zinc intended for batteries for long continued action should be carefully examined. Amalgamation does not protect them absolutely against

local action with an open circuit. The presence of small quantities of lead, arsenic, or other impurities, plays a considerable part. We have met with samples of zinc which were continuously attacked, however carefully amalgamated; others were more or less attacked and the action did not go on to complete destruction. Most of the sheet zincs of commerce, especially those which are not very thick, perfectly resist the action of alkalis.

2. The attack of the zinc may have been equally produced, without an escape of hydrogen, under especial conditions, as might have been foreseen. The oxygen necessary for the oxidation of the zinc may have been borrowed from the air, instead of coming from the decomposition of the water. We have pointed out this action; a plate of zinc plunged in an alkaline solution is oxidised and dissolved about the level of the liquid, which may even cut the plate in two. This phenomenon is produced more or less decidedly in all batteries. We have indicated the means of suppressing this grave inconvenience by suspending the zinc at a sufficient depth from the surface by means of a plate of amalgamated brass. We have even taken the care to cover the surface with heavy petroleum. If the zinc plates studied by Dr. Van der Ven were covered only with a shallow stratum of liquid this dissolving action may have extended over their entire surface, and suffices to explain the results which he has obtained.

The one or the other of these causes, or both together, may explain the abnormal consumption of zinc observed by Dr. Van der Ven in the two first series of experiments which he quotes, supposing that no false contact have taken place. We remark, nevertheless, that the useless consumption of metal does not appear to follow any admissible law as regards time. It is 0·4 grm. per hour for a yield of 0·075 ampères, 1·5 grm. per hour for the yield of 0·37 ampères, and becomes null for a yield of 0·43 ampères. This appears very singular; for a difference of scarcely one-seventh in the yield (from 0·37 to 0·43 ampère) the consumption of zinc, which was theoretical in the one case, becomes in the other three times what theory demands.

"Our experiments," says Dr. Van der Ven, "indicate the lower limit of current intensity, a limit which in an element of any dimensions whatever, but filled with an alkaline solution of 30 per cent. cannot be reached without the production of electricity being carried on in a more and more costly manner."

An immediate consequence of this manner of interpreting the results would be that by decomposing an element of any dimensions whatever, giving a yield of 0·43 ampère into six small elements and the external conductor itself into six equal wires, we should obtain a system where the same total electric circulation would correspond to an outlay five-fold the original outlay. In fact, each elementary couple would then yield 0·071 ampère, very close upon the yield of 0·075, which, according to Dr. Van der Ven, gives rise to a consumption five-fold the electro-chemical equivalent of the current. The simple juxtaposition of the active surfaces and the wires would have thus an influence upon the phenomena which it is equally difficult to admit and to explain.

Messrs. Lalande and Chaperon in a communication to *La Lumière Electrique* say:—

We are convinced that Dr. Van der Ven will find, on continuing his experiments, that accessory phenomena of the kinds indicated are the only cause of the apparent anomalies in the relation between the quantity of electricity and the active consumption of metal. We thank him, moreover, for the candour and the loyalty to truth which he has shown in recognising the justice of our observations on his former research.

The Blackpool Electric Tramway.—Fair progress is being made with the electric tramway lines at Blackpool, states the *Mechanical World*. A beginning has also been made at the south end of the promenade, a considerable portion of which is now being prepared for the reception of the lines.

EDMONDSON'S CALCULATING MACHINE.

THE great calculating machine of Mr. Babbage, made fifty years ago, and that of Scheutz, which has been at work in the office of the Registrar General since 1862, being adapted only for the calculation of tables, belong to a class of instruments not adapted to the general work of computors. They are too large, too complex, and too costly.

More than thirty years ago a smaller and simpler machine was patented by Mons. Thomas de Colmar. This instrument, made in Paris, has met with an extensive and steadily increasing sale, being largely used by insurance and other offices, where much computing has to be done.

Up to a recent date no other machine has been available, except an American one by Mr. Grant, which, though more compact, is less convenient and more limited in its range. An English machine, on the same lines, and with the same powers as the French instrument, has recently been introduced by Mr. Tate, of London.

With the exception of one small, though important item, adopted very early on, the de Colmar machine has been without improvement since its first introduction. Until recently, indeed, it seemed as though calculating machines for general use had reached their highest development. This, however, is no longer the case.

Mr. Joseph Edmondson, of Heath Avenue, Halifax, has brought out a new machine presenting several points of novelty. Certain springs, of which there are from 24 to 30 in each of the old machines, and which are a source of endless trouble, are entirely dispensed with in the new instrument. Its action is based on the same main principle as that of Mons. Colmar, but being thrown into the circular form, which introduces the principle of *endlessness*, its powers are greatly enlarged. Though constructed primarily to bring out a product, or to deal with a dividend of 20 figures, this is by no means the limit of its operation. For, by recording and erasing sections of the product or quotient as they come out, the circular form allows of the continuance of the work *ad infinitum*. Thus, with a multiplicand or divisor of not exceeding eight figures a multiplier or dividend of any number of figures, however great, can be conveniently dealt with, and a quotient can be carried to any number of decimal places. Any portion of a product or quotient can be easily and quickly erased by a very handy attachment to the machine.

Even the multiplicand is not limited to the eight figures above named. The pamphlet of very complete instructions accompanying each machine shows how 12 figures can be multiplied by 12 figures, by recording and erasing the product of 24 figures in three sections. We observe that this might be carried even further than is shown by the pamphlet, the limit of the process being only reached when a multiplicand of 16 and a multiplier of 12 figures are worked, resulting in a product of 28 figures.

These are very extensive powers—far beyond those of any preceding machine—but they are not the only ones arising from the circular form. Our space, however will only allow of our referring to one, which, as it happens, is not directly mentioned in the pamphlet. There is a curious defect common to all the sizes of the de Colmar machines. Taking an "eight figure" machine as an example—it is constructed to deal with a dividend of 16 figures and a divisor of 8 figures or less. But if the diviser be reduced by even one figure, the work cannot be completed without changing the place of the divisor on the machine at an intermediate stage of the process. The same remark applies to dividends of 15, 14, 13, 12, 11 and 10 figures, with divisors of not exceeding 6, 5, 4, 3, 2 and 1 figures respectively. This defect does not exist with the circular form.

But we must describe the instrument and its action. Fig. 1 is a perspective view of the machine; fig. 2 is a plan of its upper surface as presented to the eye of the

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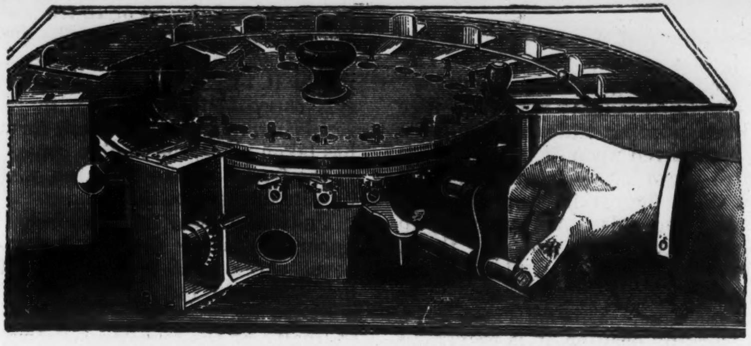

FIG. 1.

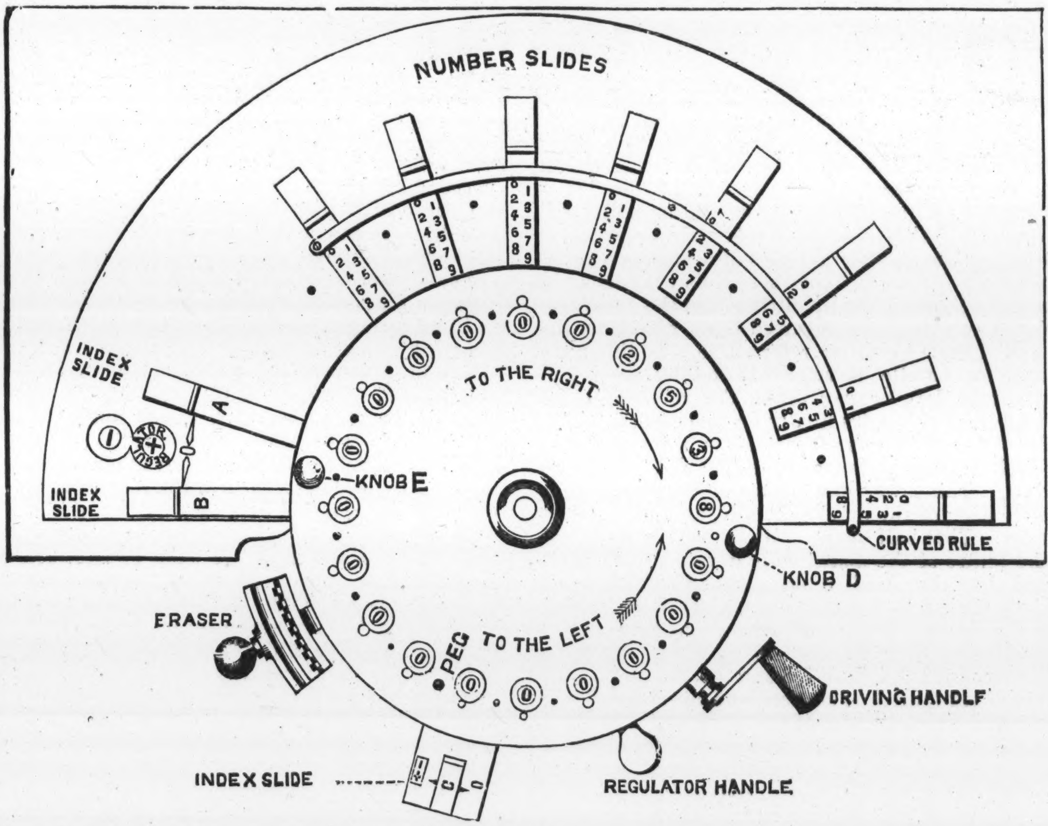

FIG. 2.

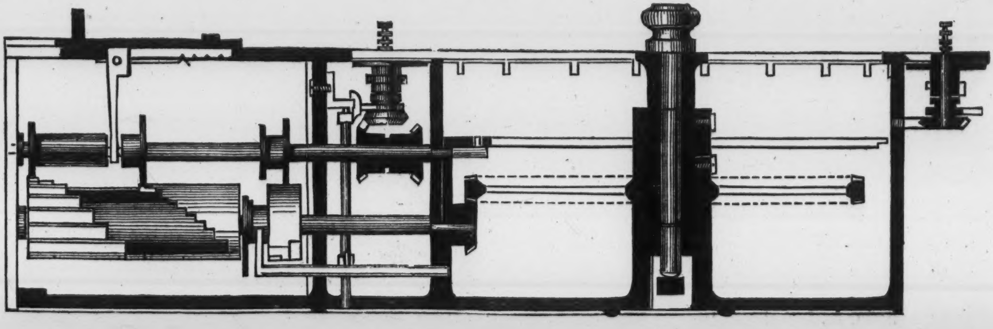

FIG. 3.

operator when seated in a position for working it; and fig. 3 is a section through the third number slide counting from the left.

The machine consists, first, of a semi-annular face plate, under which is the greater part of the mechanism, and upon which are eight "number slides" and two "index slides," placed radially with the centre of the instrument. Each number slide has the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 engraved upon it, and, as it is moved from the centre towards the circumference of the machine, it brings these figures in succession immediately in front of a curved rule. Any number, up to eight places of figures, can thus be "set on to" them. One turn of the driving handle will then add them to, or subtract them from the figures opposite to them on the second part of the machine. This is termed "the circle." When in its working position it is prevented from moving on its central spindle by pins on its under side, fitting into notches in the frame of the machine.

Near its circumference are 20 apertures, through each of which appears a figure on a disc beneath it. Each disc revolves on an axis terminating in a milled head projecting above the circle, and has upon it the digits 0 to 9 in orderly succession.

The circle may be lifted entirely out of its place, when it will disclose its underlying mechanism. At the end of the spindle of the driving handle is a bevel wheel, gearing into the upper side of the main bevel wheel, whose under side gears with all the lower radial axes (hereafter described) extending under the semi-annular face plate. Above this main bevel wheel is a circular plate, having a series of cam slots near its circumference. Into each of these slots projects a pin from a shaft carrying a clip fitting into the groove of the tube connecting two reversed bevel wheels on the upper radial shaft hereafter referred to. To this plate the regulator handle is attached, and by moving it from right to left, or *vice versa*, the reversed bevel wheels are moved longitudinally on their shaft.

Under the semi-annular face plate and immediately under each number slide are two radial axes, one above the other. The lower one makes one revolution for each revolution of the driving handle, and has upon it a cylinder. That half of the cylinder which is farthest from the centre of the machine is devoted to reckoning; and the other half to stopping and locking the axis above it, until the moment when the reckoning half, or "reckoner," begins to operate. The "reckoner" is again divided into 10 sections, on which there are respectively 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 teeth, and a considerable blank space, the section with nine teeth being the farthest from the centre of the machine. The eight teeth of the next section are a prolongation of an equal number of the teeth of the preceding, and so on for each section. So that to the eye the reckoner presents a series of successively decreasing teeth, and from its stepped appearance it may be termed a "stepped reckoner." The stopping or locking half of the cylinder is also stepped to correspond with the stepped reckoner. On the upper axis is a tube, free to slide longitudinally, and having a key fitting into a groove in the axis. The tube carries at its outer end a pinion of 10 teeth gearing with the stepped reckoner, and at its other end a star wheel of 10 rays fitting the stepped stop. A fork projecting below the number slide fits into a groove round the tube, so that the motion of the number slide is communicated to the tube, whose pinion is thus placed in position to gear with that section of the reckoner, the teeth of which correspond in number with the figure in front of the curved rule. The pinion and star wheel are at such a distance apart that the latter is always upon the section of the stepped stop, corresponding to the section of the reckoner, with which the former is placed to gear.

On the lower axis, and nearer to the centre of the machine, is a piece movable longitudinally, but carried round with the axis by a pin fitting into a hole at the end of the stepped stop. It is composed of the "secondary carrying tooth" and its corresponding stop, there being an incline on the inner edge of the latter, the use of which will be presently explained. Just above this movable piece there are, *fixed* on the upper axis, a second pinion of 10 teeth and a star wheel. The pinion is so set, that when the piece below it is close up to the stepped stop, the secondary carrying tooth passes it by; but when the piece is moved inwards, this carrying tooth gears with the pinion, and when revolving, moves it one tooth forward. As soon as this has taken place, the incline comes in contact with a pin in the frame of the machine, which pushes the piece into its former position.

Under the discs on the circle the before-mentioned upper axis carries the two before-mentioned reversed bevel wheels of 10 teeth each, on a tube free to move longitudinally, but carried round by a key fitting into a groove on the axis. These wheels are moved longitudinally by the regulator. Between them (and in gear with one or other of them, according to the position of the regulator) is a similar bevel wheel on the spindle of the corresponding number disc, and above the wheel is the "primary carrying tooth." As the pinions and the bevel wheels have each 10 teeth, and the number disc has 10 figures, every tooth which the pinions are moved counts one, either forward or backward on the disc. When the figure in the aperture over the disc passes from 9 to 0 in addition, or from 0 to 9 in subtraction, the primary carrying tooth passes the wedge-shaped end of the upper arm of the carrying lever, which it pushes back. This carrying lever moves on a perpendicular axis. Its lower arm clutches a pin in the shaft of a fork under and parallel with the lower axis beneath the next higher number slide. This fork fits into a groove round the movable piece of the secondary carrying tooth, which it shoots inwards into position for adding or carrying 1 as above described.

Each lower axis is timed to operate on the pinions above it, at least one tooth later than its neighbour to the right, to allow time for the latter to shoot the carrying tooth.

It will be seen that each revolution of the driving handle and consequently of the reckoners, causes the latter to move the pinions above them as many teeth as there are on the sections of the reckoners over which the pinions are respectively set by the number slides. This motion of the pinions is communicated to the number discs, and therefore adds or subtracts accordingly.

Multiplication being nothing more than repeated additions, it is only necessary to set the multiplicand on to the number slides, and, with the regulator set to +, to give as many turns of the handle as will equal the value of each digit of the multiplier. Thus, to multiply by 4 or 7, give 4 or 7 turns of the handle respectively. When the multiplier consists of more than one digit, the circle must be moved one step or digit to the right after each has been worked. Division is practically the reverse of multiplication, one of the "index slides" being set to record the quotient.

The machine is made by Messrs. Blakey, Emmott & Co., of the Northern Telegraph Works, Halifax.

It need hardly be said that the machine will work the four fundamental rules of arithmetic with absolute correctness. In the multiplication and division of large numbers, as well as in the combined operations of multiplying and adding, or of multiplying and subtracting it effects a great saving of time and brain power.

In multiplication the time taken (after the figures are set on to the machine) is two and a quarter seconds, on the average, for each figure of the multiplier. Thus—

$$93857926 \times 987416381792 = 92676853693421283392$$

can be reckoned in less than half a minute. Hence, although the setting on of the figures takes nearly double the time required to write them, there is an immense saving on the whole.

The machine multiplies and adds, or multiplies and subtracts *in one operation*, which takes no more time than multiplying alone.

In division, two and a half seconds suffice, on the average, for reckoning each figure of the quotient.

The brain is relieved of all the drudgery of reckoning; the attention being simply directed to arranging the work and working the machine.

Wherever large numbers or long calculations have to be worked in any way beyond mere addition or subtraction, the machine is invaluable. It is to reckoning, what the sewing machine is to needlework. It turns so easily that the handle only requires to be held between the tips of the thumb and two fore-fingers.

THE ELECTRIC LIGHT AT THE PRINCE'S THEATRE.

By **ERNEST L. BERRY**, Electrician-in-Charge.

This Theatre, which is a new one, was opened in January, 1884, by Mr. Edgar Bruce, and the installation was carried out by Messrs. Strode and Co., of 48, Osnaburgh Street, N.W.

The trial run was made on January 16th, 1884, and proved very satisfactory, and the theatre was opened publicly on the 18th of the same month, since which time the installation has been running without a failure.

The engine power is obtained from a 12-H.P. Clerk's patent gas engine, manufactured by L. Sterne and Co., which has, on the whole, worked most satisfactorily, though in December last it had to be thoroughly overhauled, owing to the water circulation having become stopped on account of a thick deposit of lime in the water-jacket of the cylinder, and which had also caused the slide valve to cut slightly, owing to the water not circulating round it. Since then the engine has run as well as could be wished. The engine is also used for driving the pumps which pump the water from the waste tank underneath the engine-room to the curtain and lift tanks at the top of the house.

The dynamo is a Siemens SD_1 machine, giving an average current of 60 ampères, and an E.M.F. of 124 volts. This machine has given no trouble whatever, and is in as good condition now as when it was first put down, with the exception of the wear on commutator (which on being measured after twelvemonth's work was found to be $\frac{5}{16}$ of an inch). The machine has used in that time $5\frac{1}{2}$ pairs of brushes, 4 inches wide, made of No. 17 B.W.G. copper wire.

The installation comprises 57 four-H.P. Faure-Sellon-Volckmar accumulators, and 307 16-C.P. 108 volts Swan lamps. For the first six months none of the accumulators were touched, but during the last half of the year 18 boxes have required attention, and of these eight have been repacked with new positive plates.

Among the positive plates (positive-pole-plates) taken out, a great many were found to have lost as much as from 35 to 40 per cent. of the paste out of them, whilst the negative plates (negative-pole-plates) showed no signs of depreciation whatever. After twelve month's work the boxes showed no signs of leaking, and were all in very good condition. Each box contains 29 positive and 30 negative plates with gun-metal connections. They are coupled up in series, and there are 49 or 50 in circuit during the time the lights are on, the rest standing by as a reserve. The dynamo, as a rule, is run during discharge of the boxes, though the boxes have stood discharge without the machine, for supplying the whole of the lights, during the performances on five different occasions. During the performance, the lights in the front of the house and corridors (with the exception of a circuit of 75 lamps in the vestibule and foyers, and on the grand staircase, which are always on) are either switched out altogether, or they can be lowered by means of reducing switches; but before and after the performance, and during the time the curtain is down, the lights are all full on.

One great fault with the lamps used is that they are fitted with the slender side lugs, which caused no less than 21 to become useless through the lugs breaking off.

The lamps are distributed over the theatre as follows, viz.: Four clusters of 19 each in the ceiling; 21 in clusters of three round the dress circle; 27 in clusters of three round the first circle; gallery, 6; first circle, 6; dress circle, 4; pit, 6; first circle corridor, 7; dress circle corridor, 7; stalls corridor, 10; royal room, 4; stalls foyer, 12; dress circle foyer, 10; grand staircase, 13; fernery, 6; kiosk, 12; box-office, 2; vestibule, 6; offices, 13; Mr. Bruce's dressing-room, 3; footlights, 50; under stage, 3; engine-room, 3. And in addition to the foregoing, lamps have several times been used on the stage.

The lights at this theatre have proved a great benefit, as all the decorations are of a very delicate character, and it has been highly appreciated by all visitors to the theatre.

Subjoined is an abbreviated account of the working expenses for twelve months.

		£	s.
Wages (electrician and assistant) ...		220	0
Gas used on engine		190	0
Lamp renewals; as follows—			
Broken by accident ...	25	23	15
" loops ...	21		
" filaments and dull	49		
	95		
Lamp shades		1	0
Oils		11	15
Brushes (for machine)		1	10
Sulphuric acid (pure)		1	0
Sundries (waste, &c.)		3	10
Total working cost for the year ...		£452	10

During the twelve months the engine has been run 2,985 hours, and the lamps were burning for 1,340 hours. Appended is the opinion of Mr. Edgar Bruce:—

"I can certify to the most satisfactory working of the electric light at the Prince's Theatre during the past 12 months. It has never failed on any one occasion owing to working from accumulators instead of direct driving, and the light is thereby rendered perfectly steady.

"Edgar Bruce.

"Prince's Theatre.
"*18th January*, 1885."

ELECTRIC LIGHTING FOR STEAMSHIPS.*

By **ANDREW JAMIESON**, Assoc. M. Inst. C.E. and F.R.S.E.

DISCUSSION.

(*Continued from page* 308.)

Mr. A. Reckenzaun wished to bring before the members an ingenious method of driving dynamo machines of small power invented by Mr. Raffard,† of Paris. The chief advantage of that kind of gearing was its silence; and secondly, it occupied only a small amount of space. The distance between the centres could be very small. With a 4-feet flywheel, a 2-feet stretching wheel and a 6-inch pulley, the whole distance from the top to the bottom was only 8 feet 5 inches. Then there was a uniformity of motion, and, above all, equilibrium upon the driving pulley of the dynamo, so that the stretch upwards was as great as the stretch downwards, and the dynamo could be easily lubricated. The inventor had told him that if the whole arrangement was made theoretically correct, the bush could be taken out of its bracket and worked in air; but of course that was an exaggeration. With reference to accumulators, they had been in the market for three years, and a good deal had been said for and against them. During the first few weeks much was said in their favour, but it had since been found that very little could be done by them. They had, however, been improved considerably within the last few months; but he was aware of only one instance in which accumulators had been introduced on board ship; that was in the case of the *Chimborazo*, where a small installation was fitted with 25 1-H.P. accumulators of the Faure, Sellon and Volckmar type. From the report of the engineers, it appeared that they had given every satisfaction during their voyage to Australia and back, but half-way on the voyage the dynamo machine got injured, and the whole had to be given up. That, therefore, was not a proper test as to how long accumulators would last. He believed the time would come when accumulators would be used as regulators on board ship.

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* From the Proceedings of the Institution of Civil Engineers.

† This may be found in the Electrical Review for May 12th, 1883.

Mr. J. F. **ALBRIGHT** said he had gained experience in the lighting of between thirty and forty vessels. The paper marked a time when electric lighting for ships was beginning to be dealt with in a thorough and scientific manner. Mention had been made of several essential points to be considered in selecting the dynamo to be employed; but there was one point that he regarded as all-important, to which no allusion had been made. How was the machine to be protected from oil, water, and dirt? He had found that the action of these three things, combined in many places with high temperatures, broke down the insulation more quickly and certainly than any other cause. Recently the machines of two well-known makers had to be removed, after a few months, solely on this account. A good deal had been said about various engines and various methods of using them; but he thought that perfection in dynamo-driving on board ship was still a long way off. Take the Westinghouse engine, for instance. He could not say that those he had had to do with were thoroughly satisfactory, and he believed that even in the *Arawa*, which had been alluded to in the paper, matters had not gone smoothly in the engine-room. He would rank Brotherhood's improved engine, or Willans's compound engine, far before it; nevertheless, he considered all those high-speed engines, as far as they were known, eminently suited to run in the shops where they were made, and fairly reliable in careful hands on shore, but pitfalls for the unwary when placed in cramped, dirty holes, generally cut out of the coal-bunker on board ship. There were special circumstances under which only those engines could be used; but as a rule he held that the average marine engineer, whose time was well filled up, should have, to start with, an engine of which he could see the working parts, of the same type as the donkey-engine, and pumps, inasmuch as he understood their management; and if the rest of the plant was well-found and placed, everything would be successful. As to gearing, belt driving had not found much favour, but endless rope gear, with one guide pulley, proved satisfactory. It had nearly all the advantages of that alluded to by Mr. Reckenzaun. It was easily renewable, it worked with a very short distance between centres, well within the range of the 8 feet referred to, and would be sufficient for two-hundred-light plant. The strain throughout was even, and not excessive, and in case of any unforeseen accident, ropes could always be found on shipboard, which would enable the lamps to be lighted. Mr. Mordey had stated that the frame of the machine should be insulated from the ship; but how could that be done, except with a rope or belt-driving? With any form of direct-driving or friction-driving, how was it possible to insulate the machine from the engine, and the engine from the steam-pipe? He had also known multiple rope-gear work extremely well. Friction-gear, as at present arranged by Messrs. Siemens Bros., had no doubt done good service, and permitted of the transmission of the full power without serious slipping. It was, however, absolutely necessary to keep the pulley entirely free from oil, wet, or dirt—no easy matter on shipboard. He was also of opinion that in this arrangement there was a want of stability in the machine, which involved considerably increased wear and tear. Generally he thought that placing the machines in some dark, inaccessible corner, was courting neglect and failure, and that the electrical engineer should insist on proper and sufficient space being provided. Referring again to the dynamo, he always found that in spite of every precaution the factor of safety for marine work must be higher than for land work; in other words, a machine whose normal output was, say, 200 lights for land work, should be only expected to suffice for about 150 on shipboard. In this respect he went further even than Mr. Siemens. The author had given some interesting figures in regard to the effects of gyration, but looked at carefully they appeared to him to prove that the effects often ascribed to gyration must be traced to some other source. He had known dynamos of the large-disk type run well athwart ship, while dynamos of the drum-armature type became heated. He thought the time when trouble was to be looked for was when a ship had a constant list for several days, and that the heating then occurred owing to the end pressure on the collar, and also partly to the fact that the oil did not run freely up the inclined shaft and bearing. Whatever the cause, the result was the same. As a general rule athwart-ship dynamos were a mistake. He thought the author placed the single-wire system in a too favourable light, but this was perhaps due to his renunciation of it having been recent, as only this time last year he considered it theoretically correct and permissible with due precautions. As a matter of fact the single-wire system necessitated the branches in most cases being double, and thus the saving in money was chiefly in the mains, and would not be more than about two per cent. of the whole cost. It also appeared certain that even where copper washers were used at the joints with the ship's skin, the two metals would corrode, and ultimately introduce resistance, and he believed that at a period when the single system wanted rewiring, the double system would still be intact. Dr. Hopkinson had already explained the difficulty of testing any single-wire system, and Mr. Albright agreed that it was a very important point. An advanced advocate of single-wiring once said to him that all the double-wire work was generally more or less earthed in a fortnight, to which he naturally replied, "Then all your single-wire work must be generally more or less short-circuited in a week;" but no advocate of the single-wire system would ever allow that. He did not approve of electrical specifications, as, with some exceptions, they were so often only a nuisance, and did not after all ensure good work. Then, again, the inspector who had to examine the work paid a few casual visits to the ship, and wound up by making an insulation-test, having probably never wired a ship in his life. He had known of instances in which full tests were arranged for and made at the close of the work by an inspector. High results were obtained, and every one was satisfied, noboby at the time being aware that the turning off or on of a single switch rendered the test valueless. He should like to know from the author at what stage of the work he considered 10,000 ohms per volt were obtainable; his own experience was that it was only before the cut-outs, fixtures, and switches were in place, and he doubted if any tests made after these were up were ever influenced by want of insulation in the wires, unless some gross defects existed, such as a short circuit or dead earth. When the fixtures were up, the surface leakage at the various points was so great with the damp atmosphere on shipboard, that tests designed to detect imperfect insulation became almost impossible. He thought that an insulation-test made when the dynamo was at work and the ship lighted, giving 200 ohms per volt, might in all ordinary cases be considered satisfactory. It would be interesting to know what the author considered good arrangements for mast-head and signal lights, which had to be impervious to wind and weather, and yet removable at a moment's notice; and also how he would specify that the wires fitted in the stoke-hole should be protected from the heat, which destroyed all ordinary insulation. In conclusion, he would say that it was only by carefully considering these various points, by arranging the fittings so that they were almost proof against dirt and water, and designing all things in the most simple manner, while at the same time making them exceedingly strong, that an electric installation on board ship could be expected to keep in order any fair length of time. But while considering all these questions carefully, and seeing that the specification, if there was one, was sound, he would say to the iutending purchaser, "Above all things put your work into good hands."

Mr. **ALFRED R. SENNETT** said that the difficulty suggested by Mr. Mordey, with reference to the Foucault currents in Mr. Jamieson's electric governor, could be overcome by the employment of a brake in conjunction with the wheel, which might then be of any material, not necessarily a conductor of electricity. But he thought it was a mistake in such governors to require electricity to do the work of governing. In such devices it was preferable to employ electrical energy merely as a governing agent, which would cause the energy of the motor itself to be utilised in performing the mechanical operations necessary for varying the expansion, actuating the throttle valve, or whatever was thought advisable. The governing device, in which one of the wheels moved bodily round the shaft, was a modification of the chronometric governor of the late Sir William Siemens, in which use was made of an encyclic train. Mr. Sennett then explained the governor of Sir William Siemens which had been successfully employed in regulating steam-engines, and he pointed out how a light disk, provided with an electric brake, so as to convert it into an electrical governor, might be substituted for the conical pendulum; in which case the electricity would only be required to actuate a light and delicate brake, the work itself being performed by the motor. Sir William Siemens employed the energy stored up in a heavy revolving ball; but Mr. Sennett did not think it was correct to endeavour to govern the action of an electrical circuit by the speed of the engine. He considered it preferable to render the speed of the motor as uniform as possible, but to control the electrical energy either at the dynamo, or by providing means for absorbing any abnormal amount of electrical energy. The author had stated as a requirement of the dynamo that it should give a constant electromotive force at a constant speed. He could not agree with him in this respect. A more valuable electrical generator would be one in which a reasonable fluctuation in the speed might take place without producing any difference in the electromotive force, and he thought that this would not be a problem very difficult of solution. Suitable means, for instance, might be provided so that the strength of the magnetic field might be diminished as the speed of the generator increased, and the electromotive force be thereby rendered constant. The breakage of lamps upon the passing of an abnormal amount of current was probably due more to a sudden molecular shock experienced by the filaments than to the increased temperature, which lasted only for a short space of time; and this he considered was to some extent borne out by the fact that the life of lamps was increased by adopting the precaution of heating them up gently upon lighting, and diminishing the temperature gradually upon extinguishing them. The question in his mind was whether damage to incandescent lamps did not occur in a space of time so short that the effect was imperceptible to the eye; and he thought that advantage would accrue from the use of a battery of accumulators placed in multiple with the lamps in the branch nearest the dynamo, as this to a great extent would take up any increase of electrical energy due to a sudden rise in the electromotive force. The author had given only a brief review of the advantages which must accrue from the employment of the electric light on ship-board; he should like to know if the premium of insurance of ships was reduced on its adoption. The author had mentioned the danger arising from the storage of inflammable oils, paraffin, &c. The risk, however, was not so much dependent upon the actual storage, but rather in taking the inflammable materials from store, and in their subsequent use. The safety of ships from fire would be greatly increased by the employment of accumulator hand-lamps, which were self-contained combinations of an electrical accumulator with a 5 or 10-candle power lamp, the weight of which, with a sufficient storage capacity for a reasonable length of time, need not exceed from 4 to 7 lbs. A number of these, each provided with a switch, so that they might be lighted and extinguished at will, might be hung in various parts of the ship, and employed in such operations as examining the propeller shaft, the cargo, the coal bunkers, &c., and the use of matches be prohibited. He was pleased to hear the arguments by some of the speakers against the employment of the single-wire system; he should like to ask the author what was the money balance in favour of this system, after deductions had been made for the expense of fitting it up, with the extra care and precautions necessary. As the lamps must of necessity be pretty close together, and not far distant from the generator, he considered that the extra resistance due to the double lead was not a point of much moment. It was clear from the remarks of several of the speakers that electrical accumulators were not regarded with much confidence at present. Mr. Sellon had mentioned accumulators which had been in constant use for more than a year with satisfactory results. He might state that Dr. Frankland had had a battery of his accumulators at work performing general domestic electric lighting for about two years. The author mentioned that a reducing valve was employed with advantage when working off the main boilers, thus wire-drawing the steam. This seemed to him an unscientific method; why not vary the degree of expansion in the engine?

Mr. JAMES HAMMOND wished to refer to the pressure of a shaft on its bearing as applied to any marine engine. If the shaft was rotating in the bearing, the pressure at the bottom would be greater than the pressure at the top, and consequently the friction at the bottom would be greater than the friction at the top; this would cause the pressure on the one side to be greater than the pressure on the other. Consequently, instead of having the maximum pressure actually at the lowest point, it would fall somewhere near the lowest point of the bearing. Of course, if the shaft were actually at rest there would be no pressure at all on the upper half, and every portion of the lower half would sustain pressure. When the shaft was placed fore and aft, the roll of the vessel simply shifted the point of maximum pressure more to one side or the other; but if it was placed athwartships the rolling of the vessel tended to elevate one end of the shaft and depress the other, and so throw the pressure of the shaft against the top bearing and against the bottom alternately. In a machine where steadiness was everything, the proper position would certainly be fore and aft, and not athwartships.

Mr. W. WORBY BEAUMONT suggested that electricians who had shown ingenuity in inventing new terms should invent another to express the name of what had been called a curve. Though not confusing to those accustomed to characteristic "curves" it might be to those who approached the subject for the first time. With respect to the pressure on the bearings of a dynamo machine, whether placed fore and aft athwartships, it appeared to him to be a question not as to how much it was when the dynamo was placed with the spindle athwartships, but as to the difference between that and what it was when placed fore and aft; after all, the extra pressure brought to bear was, from a mechanical engineer's point of view, really a very small thing, and would not have any effect upon a machine designed by an engineer accustomed to plan machines that should run for any length of time without giving trouble with the bearings. How small that additional pressure was might be gathered from one circumstance. It was shown by the formulæ due to Sir W. Thomson that the pressure was proportional to the distance between the two bearings. As an extreme case, to show the application of Sir William Thomson's formulæ, the author had taken a machine in which the armature weighed 500 lbs., the radius of gyration was 1 foot 3 inches, and the distance between the bearings only 18 inches. He thought it would be admitted that there were hardly any, if any, machines made with an armature of that weight with the bearings so small a distance apart. In most machines they would be more nearly double that distance, and, as the pressure upon the bearings was proportional to the distance, instead of having an extra 930 lbs., which after all was not much, they would only have about 465 lbs., and there was no machine made that would be affected by that as an addition pressure. The author had touched first upon the selection of engines and fittings, and next upon the method of driving. It seemed rather difficult to separate the two, but if they were separated he thought the method of driving should be first considered, inasmuch as it determined what the character of the engine should be. A good deal of difference of opinion had been expressed as to the relative merits of direct-driving engines and of low-speed engines, and in the paper one or two statements had been made as to the governing of the engines. The author had stated, with reference to one of the high-speed engines, that in spite of having tried all the best governors, the speed varied 25 per cent. But, as Mr. Paxman had observed, governing was not altogether a question of the governor, but a question of the whole engine. It would be useless, for example, to have the best governor that could be found for some of the donkey-engines that might always be heard grunting as they were doing their little bit of work in feeding the boiler. Nothing in the way of a governor would make one of those engines run regularly. The same might also be said, in a less degree, of some of the small engines for other purposes. The suggestion had been made that none of the electrical devices spoken of worked except by a difference in current or electromotive force, and consequently must follow instead of being synchronous with variations of the speed of the engine. The author had also suggested that it was necessary that engines should run within 5 per cent. with a load varying 90 per cent., and with a boiler-pressure varying 10 lbs. He should like to ask practical electrical engineers whether it was necessary that engines should be fitted with anything, electrical or mechanical, that would keep them running within 5 per cent. with that fluctuation in speed. The author appeared to speak as though he meant that the engine was fluctuating constantly within that range of 90 per cent. As far as he knew, no electrical engineer would arrange any installation in such a way that it should be necessary that the governor should be able to keep the engine within 5 per cent. of a normal speed, with a range of working altering 90 per cent. continually. It might be that at one part of the day, or at one part of the period during which lighting was going on, there might be 90 per cent. more work than at another, but the time was generally known to those who had the installation in charge, and to the engine driver, who could regulate the steam supply accordingly, and it appeared to him that there was no necessity to make the engine in such a way that it should be able to run at a uniform speed with work varying up and down through such an enormous range. But, even if that were so, it was not altogether a question of the governor, but was also a question of the engine. No electrical governor would anticipate alterations of speed in the engine, and he believed that good mechanical governors were made that would work as quickly as any electrical governor yet described; because, although the electrical arrangements acted in less than an assignable length of time, still they had to do so through certain mechanical devices, through details that were connected with other details. The most successful one was worked by a water-piston that was controlled by means of a small equilibrium-valve driven by means of a lever that was actuated by means of something moved up and down by a solenoid. Through those means there would, unless great care was exercised in keeping them in order, be a sufficient loss of time to make the operation slow, or a very little faster than a good high speed governor acting with an automatic cut off as described by Mr. Paxman. Unfortunately, the author had not thought it worth while to give some particulars which would have been of great interest. Referring to governors, he had stated that he had recently heard of a case in which fifty out of two hundred Swan lamps had suddenly broken through the failure of a governor, but he had not stated what the character of the governor was, or the way in which it worked. If he had given that information, electrical engineers might have avoided that kind of governor in the future. He then suggested that an electrical governor was the only thing to be used. Mr. Beaumont did not know that an electrical governor was not the best thing that could be used to govern a dynamo machine; but even suppose there was one satisfactory in every respect for the engine, it might be a question whether a position close to the engine, near oil, steam, dirt and heat, would be a good thing for electrical apparatus. It might also be remarked that, though the author had heard of a case in which fifty Swan lamps had been destroyed because of the failure of a governor, it was not necessary to condemn all governors, and rush to something electrical, and especially not to such an apparatus as he had described. Mr. Swan had spoken of the economy of electric lighting on board ships, and had referred to engines consuming 2 lbs. of coal per indicated H.P. He should like to know whether any of the engines used on board any ship for electric lighting were worked with 2 lbs. of coal. Large screw-engines were worked with that amount of coal, and even less, and Mr. Swan seemed to think that the main engines were driving the dynamo machines. He believed that that was not the case in any of the ships in which electric lighting was used. But if there were engines working with that amount of coal, it would be interesting to know what they were, especially as the author had, he believed, under-rated the consumption of coal by engines generally used on board ship for lighting purposes.

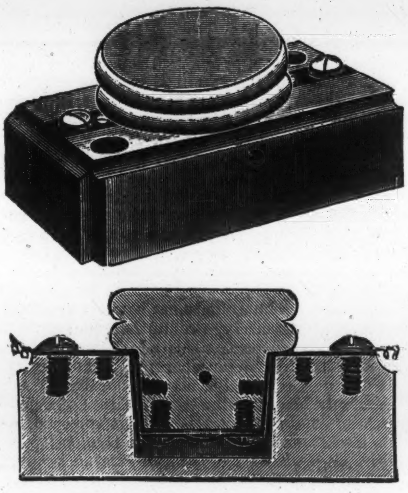
Mr. JOHN HAYES desired to draw attention to the case of the ss. *Tilly*, built on the Clyde under his supervision, which vessel was equipped with a novel installation of electric lighting machinery, the principal feature being a powerful submarine lamp, which had been referred to by the author of the paper as the only instance known to him of the adaptation of the electric arc lamp to submarine purposes. The submarine lamp here referred to was an electric arc lamp, encased in a glass cylinder 15 inches high and 10 inches in diameter, the joints at both ends being made water-tight; the current was supplied by a Phœnix dynamo, driven direct by a Gwynne "Invincible" high-speed engine, running at 650 revolutions per minute, and generating a current of 60 ampères, with an electromotive force of 40 volts, the result being a light of 15,000 candles, with an expenditure of about 4-H.P. in the lamp. At the close of the trial trip of the *Tilly* on the Clyde, he had the vessel anchored off Greenock, and at once proceeded to test the submarine lamp, by a continuous full-speed run of four hours' duration, the lamp for the whole of this time being illuminated and submerged below the surface of the sea. The effect produced was very striking and beautiful as the darkness of night came on, the four hours' trial being successfully completed at 10 p.m. This powerful submarine lamp and the ss. *Tilly* intended for fishing purposes out in the Java seas, were the practical outcome of experiments carried out by himself three years age, when, by means of incandescent lamps, he found that the electric light submerged had a strong attractive influence over fish. The *Tilly*, on leaving the Clyde, steamed direct for Batavia, through the Suez Canal.

(*To be continued.*)

A NEW CUT-OUT.

THE cut-out here illustrated is described by the *Mechanical World* as being neat and very largely used, meeting, with the use of a tin fusible wire, almost all requirements for single lamps or small branch circuits. It is the suggestion of Mr. Ruddle, of the Edison Light Company, St. Mary's Gate, Manchester, and has been worked out to its present form by Messrs. Smith, Baker & Co.

The fusible wire is screwed down by the small brass terminals in the plug, between which there is a distance of only $\frac{5}{16}$ of an inch. This plug is provided with two hard wood side guides, which, fitting into the groves of the wood socket, make the contact between the brass pieces of the plug sure and certain with the pieces in the socket, which are filled so as to project at the bottom end to ensure a good spring rubbing contact. The branch wires are attached to the two terminals on the upper part of the socket, and when the plug is inserted it is retained in its place for fear of being pulled out by a pin. By the trifling addition of a string from the pin to the plug, it will be seen at once that by withdrawing the plug and letting it hang loose, we have also a switch to cut out the lamp when its services are not required. This cut-out is extremely simple.



THE BERTHOUD-BOREL LEAD COVERED CABLES.

THE undersigned, retained by the Société des Câbles Electriques to examine and report upon the state of an electric cable, constructed under the Berthoud-Borel patents, and laid down in 1880, for the Société de Tir, at Cortaillod, met there on the 19th December, 1884, for that purpose. This cable, one of the first manufactured under the Berthoud-Borel process, is composed of 12 conductors, formed each of a copper wire $\frac{9}{10}$ of a millimetre in diameter. The cable is protected by a single sheathing of lead. The length of the cable is about 360 yards. It is placed in a trench dug along the margin of the Lake of Neuchâtel, in ground partly marshy and partly gravelly. On account of its position on the border of a lake whose level is variable, part of the cable is sometimes under and sometimes above the water, and during the winter the ground is frequently covered with ice. In our examination the cable was first exposed by digging a wide trench so as to judge of the state of preservation of the lead sheathing. We have to state that the coating of gas tar which had been applied at the time the cable was laid, in order to protect the lead, has completely fulfilled its object. The lead shows no trace of alteration, and on scratching off the thin coating of gas tar which remained adhering to the lead, the metal was found intact and in perfect condition. The insulation of the conductors was measured with a Thomson's mirror galvanometer, by the loss of charge method. For this test, whilst one conductor was being examined, the 11 others were carefully joined to earth. The following table shows the results obtained :—capacity of a conductor for a kilometre of length = 0·086 microfarad. Insulation per kilometre in megohms :—

No. of Conductor.	Megohms.	No. of Conductor.	Megohms.
1 ...	... 5900	7 ...	... 6176
2 ...	... 6176	8 ...	... 5155
3 ...	... 6123	9 ...	... 5117
4 ...	... 5632	10 ...	... 7630
5 ...	... 5632	11 ...	... 7630
6 ...	... 5516	12 ...	... 5632

giving a mean of 6026 megohms. The results obtained on the same cable on 5th May, 1883, by Doctors Kleiner, Schneebeli, and Wietlisbach, of Zurich, were: capacity = 0·090 microfarad and 3700 megohms insulation. In comparing these results with those obtained on 19th December, 1884, on the same cable, it will be observed that the insulation appears to have augmented. This probably arises from the fact that a year ago, after certain changes had been made in the signalling instruments, for which the cable was used, a small piece was cut off the cable, and the opportunity was taken of placing a sleeve filled with paraffin on the extremity of the cable. The copper wires emerging from the paraffin now have a higher insulation on account of the better protection of the ends. The perfect preservation of this cable, after having been laid more than four years, under such unfavourable conditions, is one of the best proofs of the excellence of the Berthoud-Borel cables.

(Signed) DR. A. DE WURSTEMBERGER,
Professor at the University of Berne, and Engineer to the Government Telegraph Factory.

(Signed) DR. ROBERT WEBER,
Professor of Physics at the Académie de Neuchatel.

Neuchâtel, 27th December, 1884.

[It should be noted that the cable in question is protected by only a single sheathing of lead, whereas for underground purposes the Kinetic Engineering Company usually supplies the cable with double lead sheathing, the two casings being separated by a layer of gas tar.—EDS. ELEC. REV.].

FELTEN AND GUILLAUME'S TELEPHONIC CABLES.

WE have received a copy of tests made by the Bavarian Government on an ærial telephone cable containing 27 conductors, erected at Munich. The cable was manufactured by Messrs. Felten and Guillaume, and each of the two cables tested was 1,300 m. long, suspended to a separate supporting strand, which is spanned from the chief post office, over the house tops, to the hospital at the "Gasteig," and made fast to iron standards at intervals of about 100 m. on an average. At each standard a good earth connection was provided, and made to communicate with the exterior lead covering of the two cables. For the purpose of testing the cables for induction and retardation, a conducting wire of one of the cables was connected at each end with a telephone apparatus (microphone of the Ader system), and thence to earth. The contiguous wire was connected with a telephone, and the two ends in same manner connected to earth. The three earth copper wires in the centre of the cable and the unemployed 25 conductors of the cable were left unconnected. There was no trace of induction or retardation by the experiments that were made. By means of the microphone a conversation was conducted in a loud tone on the one wire, but not a sound could be heard on the other wire, which was directly contiguous. For the purpose of comparing the clearness of tone, the same telephones were first connected with the cable wire, and then with an open overhead wire of about the same length, but no difference could be discovered in the clearness and distinctness of tone. A cable circuit was next connected with overhead wires under conditions just as they would be in practice, *i.e.*, the two conductors were provided with one and the same earth connection at the one end, but the other two ends with quite different earth connections, the latter being about a kilometre apart. Under these circumstances there was also no trace of induction or retardation, not even when the 25 remaining conductors were all connected to earth. The earth wires in the cable were next connected to earth without any change being noticed. The two cables in the hospital at "Gasteig" were then joined together so as to form one single cable 2,600 m. long, both ends of which were in the chief post office. On repeating the experiments as described above, a conversation being conducted in a loud tone on the one conductor with the microphone, there were only disjointed, and totally unintelligible, sounds audible on the immediately contiguous wire, so faint and low that they could never cause any interference with the working of a telephone. As regards the retardation, there was a diversity of opinion among those present, while some believed they noticed the tone was a little dull others were unable to notice anything of the kind. On no account could this retardation interfere with the telephonic service. The transfer of sounds from one wire to another, however faint, was further sensibly reduced, when one of the conductors, instead of being connected to the earth at the chief post office building (a water pipe) was provided by the intersection of an overhead wire one kilometre long, with an entirely different earth connection. There was then no difference as regards the clearness of tone discernable, whether the remaining conductors and earth wires were connected to earth or not. There are at present 12 conductors of one of the cables working most satisfactorily, and the above report is signed by the Director General, Royal Bavarian Public Works Department for Post and Telegraphs.

NOTES.

Electric Lighting of Steamships.—The Peninsular and Oriental Navigation Company's new steamer *Coromandel* is to be fitted with the electric light. Aluminium is to be used instead of brass for furnishings.

The Electric Light as a Preventive of Misdeeds.—We could commend to the authorities in this country responsible for the preservation of law, morality and order the remarks of the police authorities of Hartford, Conn., who say that the electric lights have greatly lessened their labour, by greatly diminishing the commission of crimes and offences. It is chiefly after the hours of midnight that the wrongdoers are busy, provided their deeds can be done in darkness, but, so long as the electric lights are kept up nearly all night, they are a great hindrance to the commission of crime. The nocturnal misdeeds in Bushnell Park, for a single example, have diminished fully 90 per cent. since the park was electrically lighted. Prowlers about the lighted parts of the city also find it more difficult to perpetrate mischief than formerly. The electric lights at once make the city, during the night, more attractive and safe.

Electric Lighting Companies in America.—There are said to be upwards of 600 local electric lighting companies in the United States and Canada.

The Electric Light for Railway Signals.—The Great Western Railway Company is utilising the electric light very largely for the illumination of the signals on its lines.

Electric Lighting in the Navy.—Contracts were placed last week, by the Admiralty, with the Anglo-American Brush Electric Light Corporation, for two "Victoria" ship dynamos. These machines are for use on board H.M.S. *Shah* and *Active*, which are now being fitted out at Portsmouth Dockyard.

The Electric Light at the Alexandra Palace.—Mr. Thos. Harrison, engineer in charge to the Gülcher Electric Light and Power Company, writes to the Editor of the *Daily Chronicle* as follows:—"In your issue of Saturday I note that you refer to the concert in the grand transept having been marred by 'a breakdown in the electric lighting.' I think it due to this company to explain that we were compelled to switch off the lamps owing to the water supply to our engine boiler having entirely failed—probably through the lodgment of some dirt in the supply pipe. I should be glad if you would kindly afford us this explanation, as otherwise the public may regard it as a breakdown in our electrical machinery."

Blunders in Electric Lighting.—The *Canadian Magazine of Science* expresses the opinion that electric light corporations do not exercise sufficient care and caution in the locating and erecting of stations where the conversion of steam power into electric energy is intended to take place, and continues: "When we see in the principal cities of Canada, stations erected at great cost and elaborately furnished with steam boilers and numerous engines running at from 6 to 8 lbs. of fuel per horse-power per hour, we cannot be blamed for criticising a state of affairs which is highly damaging to the best interests of electric lighting and ruinous to the stockholders. The present age has demonstrated beyond a doubt that, if economy is wanted, circumstances and conditions must be obtained to admit of the application and use of compound condensing engines, so as to get the maximum of power at the least possible cost. Now there is no reason why in the majority of our cities these conditions should not be fulfilled, and we think it is high time to at once shape for such a course. Take, for example, the electric lighting stations in the two first cities of Canada, viz., Montreal and Toronto. We find to our astonishment that electric light stations are located in some very undesirable and inconvenient nook, and, notwithstanding the fact that an inexhaustable source of water lies near them, also numerous locations suitable for electric light stations, where steam appliances could be arranged to run easily at one-third the present cost, old-fashioned and very expensive courses are adopted. The reason, perhaps, for all this is the fact, consulting engineers are rarely, if ever, called in to assist those less able to decide on such important matters. It is high time that such false pride and reserve were abolished, and the services of our consulting engineers valued. Parties should recognise that the obtaining of special advice and assistance from consulting engineers is attended with very satisfactory results, and, without it, blundering and loss will, more or less, take place."

Electric Lighting at Paddington.—The arrangements for electrically lighting the general offices and hotel at Paddington Terminus, and the Royal Oak and Westbourne Park stations of the Great Western Railway with incandescent lamps, are being completed. An enormous mileage of wires and myriads of lamps will be employed in the installation, which will probably be the largest of its kind in this country.

Lighting of Steamships.—The electric light is to be fitted on board the new steamer which is in course of construction at the yard of Messrs. Denny Brothers, Dumbarton, for the Union Company of New Zealand's fleet. The dynamo, which is to be capable of feeding 300 20-candle-power lamps, has been ordered from the Anglo-American Brush Electric Light Corporation, which is supplying a compound wound Victoria dynamo for the purpose.

Electric Light in a Sugar Refinery. — Messrs. Walker and Company's Sugar Refinery, Greenock, is now electrically lighted. The success is marked, and it is expected that the other refiners will shortly introduce the electric light.

Factory Lighting.—The Pontypool Iron and Tin Plate Company is lighting its tin works by means of a combined installation of arc and incandescent lamps, the current being taken from a No. 4 Gülcher low tension dynamo. There are in all 9 arc lamps of 2,000 C.P., and 23 incandescent lamps of 20 C.P.

The erecting, fitting, bridge and boiler and pontoon shops at Messrs. Hawkes, Crawshay and Son's works at Gateshead-on-Tyne are also being lighted by means of arc lamps from a No. 5 Gülcher dynamo. The lamps are distributed as follows:—In the bridge and boiler shop are placed six lamps of 3,000 C.P., throwing a perfect light over the building. The pontoon shop is lighted by one 3,000 C.P. lamp; the yard by one 3,000 C.P. lamp on a high mast; the erecting shop by three 3,000 C.P. lamps; fitting shops by six 2,000 C.P. lamps, three being in the upper and three in the lower shop, in all 11 arcs of 3,000 C.P. and six of 2,000 C.P.

The foundry of Messrs. Alley and McLellan, Glasgow, is lighted by 9 lamps of 2,000 C.P. driven from a No. 3 dynamo, the power being taken from a Westinghouse high speed engine. It is estimated that this will save a considerable amount as compared with gas.

The bridge yard of Messrs. P. and W. McLellan, Glasgow, is being lighted with 7 lamps of 3,000 C.P. placed on high masts, the current being generated by means of a No. 4 Gülcher low tension dynamo. This will enable bridge and girder work to be done as well by night as by day.

Electric Lighting of the Glasgow General Post Office.—After a series of experiments with the electric light in the General Post Office at Glasgow, extending over two years, the Government, in 1883, entered into a contract for the lighting of the building by electricity for another two years. The plant was installed at the contractor's expense, the engines, boiler, and machines being placed in the basement of the building. The contract having expired, the Postmaster-General has entered into a new contract with Messrs. Muir and Mavor, of 140, Douglas Street, Glasgow, for electrically lighting the building, the contract being on a more permanent basis than the prior one. The engines and generating plant are placed entirely outside the post office building, in premises to the rear belonging to the contractors, the whole of the wires, lamps, and other fittings inside the building having been acquired by the Post Office. The current is laid on by the contractors and charged for at a fixed rate per month. The installation at present consists of about 460 glow and 10 arc lamps. The currents are produced for the glow lamps from two 14-unit Crompton compound dynamos, while those for the arc lights are derived from three 4-unit Bürgin dynamos. The driving power consists of a pair of horizontal engines by Messrs. Marshall, of Gainsborough, each indicating 40 horse-power, steam being supplied at 80 lbs. pressure from two multitubular boilers by the same makers. The engines are connected with the driving shaft by means of double friction clutch gear, which enables the engines to be interchanged or worked simultaneously without any interruption to the light. The dynamos are driven through Hoyt's short-lap leather belting, which was supplied by Messrs. Balderston & Co., of Glasgow. Should one of the working machines become disabled, a spare one can be substituted in a few seconds. The whole of the post office is served by two circuits, one for the arc and the other for the glow lamps. The arc lamp machines are so arranged that the extinction of any group or groups of lamps does not affect the remainder. During the winter months the greater portion of the lights has frequently been required to run for 100 hours consecutively, and in every respect the working is stated to be satisfactory.

Electric Lighting in Theatres.—We publish this week an interesting account of the electric lighting at the Prince's Theatre, which house has now been open to the public for more than 12 months. The experience here gained should go far towards inducing theatrical managers generally to adopt this illuminant, and the opinion of Mr. Edgar Bruce will doubtless have a material effect upon the managerial mind. Mr. Berry, the electrician in charge at the Princes Theatre, is to be congratulated upon the success of his labours.

The Electric Light for Stage Effects.—The electric light has been introduced with extremely pretty effect in the pantomime at the Theatre Royal, Belfast. Miss A. Glover, who sustains the part of "Electra," carries four lamps throughout the whole of the performance, whilst in the transformation scene 30 additional lamps are employed as headdresses. The current is supplied by small accumulators manufactured specially for the occasion by the Belfast Electric Appliances Company, Limited, which has charge of the installation, while the lamps used are Swan and Edison 4-volt, which experience has proved to be both reliable and economical. This is believed to be the first time that so many as four lamps have been effectually run off one battery during a whole pantomime.

Electric Lighting in the Colonies.—An installation of the electric light has been successfully effected at the Eveleigh locomotive running sheds, New South Wales. There are about 500 20-C.P. incandescent lamps in one bay of the shed.

Cost of Lighting the "World's Exposition."—It is stated that the cost of lighting the "Exposition" at New Orleans by electricity is about $1,250 a day.

Another Death through Electricity.—A man attending to some repairs on the roof of a house at Cincinnati, O., a month ago, caught hold of an electric light wire and was instantly killed.

Telephonic Extensions in Scotland.—The National Telephone Company has just opened telephone exchanges at Hamilton and Larkhall. The lines are nearly 14 miles long, and have been erected along the public roads. It is also in contemplation to establish a call-box at Hamilton, where non-subscribers will be enabled to speak to Glasgow at the rate of sixpence per conversation of three minutes. The burgh authorities have placed their police-stations in communication with each other by means of the facilities afforded by the Telephone Company.

Opening of the Telephone in Arbroath.—The telephone trunk wire from Dundee, which had previously been extended to Carnoustie, now reaches Arbroath, and it was formally opened on Thursday afternoon last week. The wire is that of the National Telephone Company Limited, and it connects Arbroath not only with Dundee but also with Perth, Forfar, Newport, and other places in the Dundee circuit. At the opening, a considerable number of merchants and other business gentlemen of Arbroath, Dundee, Montrose, and district assembled. Some interesting experiments, all of them successful, were made, conversation being entered into with the company's officials and some of their subscribers at Dundee, Perth, and Newport. Two or three songs were sung and a musical box played at the Dundee end of the wire, and the music was quite distinctly recognised in Arbroath. The musical part of the connection with Perth consisted of the playing of a violin there, and in Arbroath the music of the violin played in Perth was quite plainly heard by the listeners in the company's office. The trunk wire was then declared formally open by the Provost of Arbroath, and its success was toasted, Mr. J. D. Miller, district manager, returning thanks.

Telephone Charges.—At a meeting of the Association of Municipal Corporations in London on Tuesday last, it was resolved, on the motion of Alderman Seaton, Hull, seconded by the representative of the Wolverhampton Corporation, and unanimously carried, "That a representation be made by this Association to the Postmaster-General complaining of the restrictions which the excessively high charges for telephonic communication impose upon commerce."

Establishment of a Telephonic Exchange at Portsmouth.—The long-contemplated telephone exchange has at length been started, and, judging from the present state of affairs, is likely to be liberally supported by the business men of the town. The central and only station is situate in Commercial Road, Landport, one of the busiest parts of the town; and, by this selection being made, Palmerston Road, Southsea, and many other equally important places have been included in the one mile radius, which extends from St. Luke's Church, Southsea. The derrick, which consists of two strong wrought iron columns, braced together and securely stayed, has been erected on a portion of the roof of Messrs. Pink's extensive grocery warehouses. The "switching" room is on the top story close by. In order to obviate the possibility of metallic contact, the wires, after they have been brought in from the roof through shoots and cables, which are attached to the testing board and thence to the switching apparatus, are coated with India rubber. The derrick is fitted at present to receive 100 wires, but with slight alterations this number could be increased to 300. As far as possible, it is intended to erect the wires at the back of streets, and to avoid crossing roads, and also to place the poles and standards in close proximity to each other. The wire is $\frac{3}{16}$ size. Most of the poles are of iron, but a few are of wood; the standards are all of iron. The highest pole at present erected is 45 ft., and the lowest 30 ft. It may be here mentioned that the borough engineer (Mr. H. P. Boulnois) has, after a careful inspection, approved of the manner in which the poles and other apparatus have been erected. Of course, although the radius is only a mile, much longer wires will have to be run in many cases, owing to the circuitous routes which have been, and will have to be, adopted, in order to skirt property the owners of which are unfavourable to the scheme. It is anticipated that eventually no difficulty will be found in obtaining 200 or 300 subscribers. The principal houses of business are now being connected, and in the course of a month or two the exchange (which is under the charge of two lady operators, one of whom has come from Bristol) will be in fair working order. The rates of charges per annum are exceedingly low, being: £10 for seven years, £11 for four years, and £12 for one year. According to present arrangements, the exchange will remain open from 9 a.m. to 7 p.m.; but it is probable that before long a system of all-night communication will be established.

The Fighting in Afghanistan.—The explanation of the fact that the tidings of the outbreak of hostilities between Russia and the Afghans came from St. Petersburg is, that the wire by Meshed has been cut, and consequently no telegrams had for some days reached the British Government. The Russian wire is continuous from St. Petersburg to Merv, and it was by this line that the intelligence was brought.

Three Months to deliver a Telegram.—It is stated that Edward G. Bowser, of Chicago, a real estate broker, has commenced a suit against the Western Union Telegraph Company, claiming $50,000 damages. Last spring he offered a tract of land in Texas to a syndicate of capitalists in London for $55,000. The syndicate sent a telegram offering $52,000, but the telegraph company delivered the telegram to another man of the same name. Three months later the telegraph company discovered the mistake, and sent the message to the plaintiff, but too late.

The Manchester Telegraph Clerks.—A large meeting of the Manchester postal telegraph clerks has been held, at which it was resolved to forward a memorial to the Postmaster-General, asking for overtime payment for work performed on Sundays, so as to place them in this respect on the same footing as the London clerks. Should the present memorial fail in its object, it is intended to wait on members of Parliament generally, and have the subject brought under the notice of the House of Commons.

Telegraphy and Colonial Defence.—The *Times* correspondent at Hongkong, telegraphing upon the subject of colonial defence, insists that a direct telegraph line, in English hands, between Hongkong and Singapore is urgently required, the existing cables being in French and Russian hands.

Telegraph Operators in America.—A New York contemporary remarks that murmurs of discontent among telegraph operators in the States may not be very loud just now, but no mistake is possible as to their depth and bitterness.

An Unremunerative Telegraph Office.—A public meeting of the inhabitants of Strathmiglo (Fifeshire) was convened for the purpose of knowing if the public were willing to give a new guarantee of £33 per year for the next seven years to the telegraphic department for the privilege of having the telegraph in connection with the Post Office. A considerable amount of dissatisfaction has prevailed during the last seven years owing to the small number of the inhabitants who had to make up the deficiencies. It was briefly stated that unless the public generally took an interest in the matter, in all likelihood telegraphic communication would cease. No decision was arrived at.

A Canadian Cable.—The Toronto *World* speaks as follows upon this question: "By all means a Canadian cable is specially wanted in these troublous days. Great Britain may be at war with Russia soon; nay, we may any day hear that war has been actually declared. It is a burning disgrace both to the Mother country and the Dominion, that as yet we have no cable of our own, but are dependent upon French, American and Anglo-American companies for our cable news. The important interest that Great Britain has in maintaining communication with Canada, also through Canada to the Pacific both by railway and telegraph, has never half been appreciated either here or in the old country. But if there be war with Russia the authorities will get new light on this subject flashed into their eyes, and that in the most peremptory manner."

Cable connection with the Isle of Man.—A new two-wire cable is about to be laid from a point in the Isle of Man between Douglas and Ramsey to St. Bees, near Whitehaven, Cumberland. The existing single wire cable was laid in 1859, and has frequently been repaired.

Connecting Tasmania with the Mainland.—News comes from Tasmania that the Government intends laying a cable across the Derwent from Hobart to Belleville, for the service of the battery on Kangaroo Point, and also the east coast districts.

Aerial Lines and Fires.—A large fire which consumed the Langham Hotel in Chicago recently, is said to have shown a new danger in the electrical field. Upon the roof of the hotel there had been placed a large structure by the telephone company, to which a goodly number of wires were attached. The wires leading in one direction were destroyed and disconnected by the heat, and the strain from the other side, coming upon the wall of the structure, pulled a section of it over, with the unfortunate result of burying nearly the whole of the fire patrol crew, who were at work, two of whom were killed and others badly injured.

Lighthouse Experiments at the South Foreland.—The extremely interesting and important experiments which have been in progress during the past twelve months at the South Foreland Lighthouse Station, under the direction of a Special Committee of the Trinity House, were brought to a close a few days since. The three experimental lighthouses were adapted specially for the contest of electricity, gas, and paraffin oil for the supremacy. They were fitted respectively with new electrical apparatus, with Mr. Wigham's gas apparatus, similar to that in use at the noted Galley Head Lighthouse, and the six-wick oil burners in extensive use in the Trinity Lighthouse service. In practice it has been found that a great increase of power in the electric light is obtained by running the currents from two machines through one lamp, the arc then developing as much as 20,000-candle-power in itself. The photometric measurements of these experimental lighthouse illuminants have been made for the Trinity House by Professor Adams, of King's College, who is now engaged upon his report. In dense fogs on the Foreland, by the direct testimony of observers walking towards the light, the electric became visible at distances varying from 1,900 to 1,500 feet. At the earlier part of the experiments, the oil was detected before the gas light; but subsequently the gas light was improved by the introduction of an inverted cone, and since that time the oil and the gas have been detected together at from 1,500 to 1,250 feet. In regard to the general observations made by mariners at sea, the electric light is understood to be in the ascendant; and by the personal observations of Professor Adams, Mr. Dixon, Mr. Hall, and others it has been ascertained that, with the three illuminants shown as single lights, the rays of the oil and the gas were lost at eight miles, whilst the range of the electric was maintained up to 14 miles. With the lights all at full power under their respective combinations the gas and the oil were lost at ten miles, whilst the electric was a good light at 14½ miles, beyond which it was not pursued. The most important result in the whole series of experiments is the demonstration that the intensity of the electric light is superior in penetration of fog, mist, or rain to the larger superficial volume of combustion illuminants.

Reckenzaun's Electrical Tramcars.—Messrs. G. A. Plewe & Co., of Berlin, have given Mr. Reckenzaun an order for one of his cars. Mr. Plewe himself and an engineer have recently visited London to examine into Mr. Reckenzaun's system. The car is the first of a series to be placed on the roads, and it is required by the beginning of next month for the opening of the Japanese Exhibition, and will convey passengers from the Spittel Markt, in the heart of the city, to Bauer's Ausstellung Park, about 4 kilometres in the west end of Berlin. There are signs of activity in the direction of electrically propelling tramcars of a nature to warrant the belief that the immediate future will see great progress in the development of electrical tramways.

Death of a Telegraphist in Egypt.—We regret to announce the death at Cairo, on the 29th ult., of Serjeant E. W. Steevens, Royal Engineers, from enteric fever. He was 32 years of age, and was a native of Brighton. He commenced his career as a telegraphist at the Brighton railway station, whence in May, 1870, he was transferred to the telegraph service of the Post Office. He joined the Royal Engineers in December, 1875, and served in the telegraph detachment with the British forces in Cyprus. In September last he left England for Egypt, in charge of a party of the Post Office volunteers, attached to the telegraph battalion. He leaves a widow, but no children, to lament his loss.

The "Magneta."—Grave doubts are entertained as to the safety of the ss. *Magneta*, which left the Thames for Singapore a month ago and has not been heard of since leaving the Channel.

Mr. Preece and the Watt.—Our readers will remember the remarks reproduced in our columns from the *Mechanical World* on Mr. Preece's paper respecting the value of the watt, and also Mr. Preece's letter to a New York electrical journal, referring to those remarks. A subsequent issue of that journal (*The Electrical World*), now to hand, contains the following from the writer of the notes in question in the *Mechanical World*:—"Sir:—My attention has been called to a letter from Mr. W. H. Preece, which appeared in your excellent journal of January 27th. In this remarkable epistle the eminent telegraphist indulges in some extraordinary literary "slogging," the apparent object of which is personal damage to myself, the writer of the notes in the Manchester *Mechanical World*, which have quite undesignedly raised his ire beyond the point of control. I should have been gratified if the writer had refuted my statements, or if he had simply shown that I was mistaken; as it is, I am filled with sorrow to find the man of stately presence and imposing manner foaming at the mouth because a pigmy has had the impudence to question his authority. In a note subsequent to the one he discusses, I gave him an opportunity to put himself right; but so far is he from availing himself of the offered chance, that he fortifies himself in the old indefensible position, whence he hurls mud and injurious epithets, the most telling and effective missiles in his arsenal. We have in this country a quasi-legal maxim, "No case, abuse the opposite side," which must have great charms for Mr. Preece. Apart from the unusual material of war employed by him, there is the singular method of its conduct. The *casus belli* arose in England, and there its objective is, but Mr. Preece has delivered his attack in the United States! I suppose this is strategy. First, in reply as to my style; as a technical journalist of many years' standing, I ordinarily employ the style I think will best answer the purpose I have in view. Thus, if I have an absurdity to deal with, I endeavour to reduce it to itself, and I usually bring into requisition for defence the class of weapon used against me. Mr. Preece's offensive weapons, however, being little to my taste, I shall now bring into action others with which I am more familiar. He says very elegantly that I have "run amuck on the assumption that the watt is an electrical unit," but he carefully avoids the statement that it is not an electrical unit, and otherwise fails to show that if I assume it to be such a unit, I am in error. He says it is "the unit of power," which is absolutely and unqualifiedly wrong, as every physicist knows. It is used as, and may become with advantage, a recognised *electrical unit* of power, which is a very different thing. I will go further and say that I hope it may also become a mechanical unit, but before this can be, the C.G.S. system must be adopted by mechanics, and I fear that is not likely to occur in our time. The late Sir W. Siemens was the author of the watt, which he introduced to the British Association on August 29th, 1882, in company with the Joule, and he suggested them as "additional units to those adopted by the International Congress at Paris," so that the list should read: ohm, ampère, volt, coulomb, farad, joule, watt. The gauss was also suggested, but has only been adopted by Professor Sylvanus Thompson. Sir W. Siemens showed that the adoption of the watt would provide a correlative measure between electrical and mechanical units, since it was a fraction or multiple of certain mechanical units. He was a practical mechanician, and therefore knew better than to say it was a mechanical unit. Now, I come to the actual point of contention, and in order that it may be clearly understood, I will restate it as briefly as possible. Mr. Preece stated that in a given case *n* watts were "expended" or "consumed." I responded that if an F.R.S., speaking to scientists, made such a statement, he evidently did not understand what he was talking about. He responds that his statement is correct, and adds a few definitions with which every elementary student is familiar. "Power is the rate of doing work" is one of them. I will add another, "work is done when a force overcomes a resistance;" and yet another, "in doing work (*i.e.*, in overcoming a resistance) force may be expended;" further, "if the work produces mechanical motion or heat, it is expended in producing that particular mode of motion." Now, according to the doctrine of Mr. Preece, the *rate* of consumption can be consumed! According to accepted doctrines, a thing expended or consumed still exists in another form. The expended force or energy is easily accounted for by its transformation into some mode of motion, but will Mr. Preece account for the expenditure or consumption of the *rate* of an expenditure? He affirms and reaffirms that the phenomenon exists, but refrains from showing it to us. He says that *n* watts are expended or consumed where ordinary mechanics believe that the exact opposite occurs; that is to say, in a burning candle, for example, *n* watts are originated or set up. I can only suppose that Mr. Preece, coming to the study of the question late in life, with inadequate leisure for its mastery, has got very confused, or he would never talk of the expenditure or consumption of a rate. I protest again, as I protested before, against the efforts of men of Mr. Preece's experience, who seek to interfere with what it is no discredit to them to say they do not understand. That is an admirable proverb which bids the cobbler stick to his last. I have to apologise for having written at such great length, and for obvious reasons subscribe myself R.

"Manchester, England, *February* 17*th*."

Lightning Conductors.—An examination of the lightning conductors on the buildings at Halsyde, near Glasgow, owned by the Steel Company of Scotland, has shown them to be inefficient. Their repair, and the erection of four new conductors, have been entrusted to Mr. David Tosh, of Greenock. The points of the new conductors are to be nickel-plated, the ropes to be of 7-strand by 7-strand copper wire, painted, and connected to the rods and earth plates by means of rivets and solder.

A Cement for Connections in Incandescence Lamps.—A correspondent of the *Electrical World* writes:—Electricians experimenting upon and making incandescent electric lamps have no doubt found that, in making lamps for currents of high E.M.F., they lose a great many lamps on turning on the current suddenly to the said lamps. I have experienced the same trouble, and have at last found a very easy and simple method by which I prevent any chance whatever of losing a lamp from that cause. The reason why the lamps burst is on account of a poor connection between the platinum wire and the carbon; but I found by using the following method I succeeded in making a lamp that would stand three times the E.M.F. it was made for. For cementing the carbon to the platinum wire I use 100 grains carburet of iron stove polish (Dixon's) ground dry to a very fine powder. To this I add 10 grains of lump sugar; place the mixture in a mortar and when stirred around and well mixed add to it 40 grains of gold bronze. Then I mix this fresh compound thoroughly, while dry, and then add water sufficient to make it into a thick, pasty mass. I apply this to the joint and allow it to stand twenty minutes or half an hour, then burn to a cherry-red heat by using a very fine gas jet. It will be found that it has then, when cooled off, the same appearance as any ordinary carbon cement. But during the process of pumping, the cement will be found to turn, and when the pumping is complete it will have a deep carmine colour. This you will find is a perfect and tight joint between the carbon and platinum, and will safely answer for any E.M.F. for which you make the lamp.

Fatal Accident.—Last week Alfred Thompson, a fireman employed in connection with the working of the electric light at the First Avenue Hotel, Holborn, became entangled in the machinery whilst oiling the bearings, and subsequently died from the injuries he sustained.

The Brush Patent.—*Engineering* thinks the famous Brush patent must have been a most constant source of income to no inconsiderable part of the legal profession. It has figured in scores of agreements and assignments, and has been involved in many a threatened action. Counsel, solicitors, promoters, and liquidators have all had reason to bless the name of Brush, and now not a few of them are again in expectation of more good things, for it is announced in the *Patent Journal* and in the *Gazette* that a disclaimer is to be filed. This is not the first time that the vitality of the patent has been sought to be improved by the process of pruning away the doubtful branches, but this time the knife is to be employed so unsparingly that not only are the limbs and offshoots to be removed, but what were considered the very roots and vitals are to be excised. Only one little "unconsidered trifle" of the invention will be left. This is the "teaser," or the shunt coil, which Mr. Brush proposed to add to the series coils of his electromagnets, when the dynamo was used for electro-plating, to prevent the polarity of the magnet being reversed upon the stoppage of the machine by a current generated by the inverse electromotive force of the electrodes of the bath. This is believed to be the first example of a compound-wound machine, although it was not designed for the purpose of maintaining a constant difference of potential at the poles. The directors of the Brush Company do not, of course, explain their object in thus limiting their patent, but it is not difficult to guess, and makers of compound-wound dynamos do not need to consult an oracle to divine the reason. Of course, the disclaimer does nothing more than clear the decks for action. It remains for the Courts to say whether the crude form of double winding set forth in the Brush patent was an anticipation of the present system of manufacturing dynamos for incandescence lighting.

The French Minister of Posts and Telegraphs.—The Paris *Morning News* says: "If it be true that M. Cochery is not to be retained in the department of Posts and Telegraphs, then France is about to lose one of her ablest and most conscientious officers. Throughout his long administration M. Cochery has been noted for his untiring energy and never-failing enterprise. His is a department which is every day put to the test of criticism by millions, and it is rare indeed that complaint has been made. No improvement that modern ingenuity could suggest has ever been neglected by M. Cochery; and all those who have had dealings with the Minister will regret his departure, and will gladly testify to his uniform courtesy and his brilliant business qualities."

A detailed account of the measures effected by him will be found in the translation of a report in the Journal Officiel de la République Francaise, published by us in July last. Apart from the work he has done for the general advancement of science, M. Cochery has made his mark in the history of French Telegraphs.

Curiosities of Gas Lighting.—Not uncommonly, remarks the *Engineer*, ordinary illuminating gas is passed through or over solid or liquid hydrocarbons, and increased light is obtained at the burners, to the intense satisfaction of the consumer who takes the trouble to adapt the necessary apparatus to the main pipe, and to keep up the hydrocarbon supply. No rose is without its thorn, says the proverb, and in the case of the use of other hydrocarbons to increase the illuminating power of gas, the thorn may be hidden. Mr. F. H. Varley, the electric lighting engineer, upon whose authority the following statements rest, tells us a curious story. A case once came under his notice in which twelve batswing burners, which had a gas meter to themselves because of the room being let out, were used to light a billiard table. The burners were then reduced to four, and the gas before reaching them made to pass through a carboniser containing crude benzol or coal-tar naphtha, said to give a saving of 50 per cent. in the consumption of gas. As the four burners of the same pattern seemed to the eye to give as good a light as the twelve previously used, a saving of 50 per cent, at least was expected. Everything was perfectly satisfactory until the gas bill came in, when it was discovered that, although only four burners had been going, more gas than before had passed through the meter. This was a surprise, and Mr. Varley, who had been instrumental in recommending the change, and who was loth to think his advice to be wrong, recommended a trial of another quarter of a year's duration, to see if it corroborated the first quarter's experience. The increased consumption continued; so to get at the cause of the phenomenon he tried the following experiment:—A measured quantity of common gas was passed through a washing-bottle filled with wool saturated with benzol; it was then collected in a bell glass over the pneumatic trough, when a reduction of the bulk of the gas was discovered, and on again passing the gas through the benzol vapour, a further reduction of its bulk was effected. It therefore became clear that the increased luminosity was not entirely due to admixture with the vapour of benzol, but that there was an actual condensation, or a change of the light carburetted hydrogen into a heavy carburetted hydrogen. The experiment was purely a qualitative test, and the exact amount of reduction was not accurately determined; but after several passages through the benzol, the gas lost at least 40 per cent. in volume. This shows that when the illuminating power of gas is increased by the addition of heavier hydrocarbons, experiments should first be tried to ascertain whether there be real gain or loss in the process. Had the naphthaliser been on the other side of the meter, the consumer would have effected an economy at the cost of the gas company. In consequence, he says, of the large mains now laid down by the companies, the pressure is less and the gas more attenuated; so the public get less gas than before, although the quantity appears to be the same when measured by the meter. Attenuation of the gas on his own side of the meter is better for the consumer.

Electricity for Street Railways.—The *New York Electrical Review* thinks electricians are not agreed as to the feasibleness of the scheme to substitute electricity for horse power in the operation of street railways, but states that the special committee appointed by the American Street Railway Association to investigate that question, reports that the prospects are flattering. The electric railway now in operation at Cleveland is a surface line, and the conductors which supply electricity to the motor of the car are placed in a conduit, similar to the conduit which contains the cable of the cable railways, and a brush attached to the car is said to keep the crevice of the conduit free from obstructions of mud or snow. A grade of 500 feet to the mile occasions no difficulty, and the line is to be extended to 20 miles of track next summer, the proprietors say.

The Belfast Arc Lamp (F. M. Newton's Patent).—We understand that MM. Sautter Lemonnier and Co., the well known Paris firm of electrical engineers, have just purchased the patent rights for the manufacture and use of this lamp in France. It was fully described and illustrated in the *Electrical Review* for October 18th, 1884. In the hands of MM. Sautter Lemonnier and Co. it will be sure to acquire a leading position in France.

Electrical Navigation.—At a recent meeting of the Institution of Engineers and Shipbuilders of Scotland, Mr. Allan Clark contributed a paper on "Electrical Navigation," in which he traced the history of the application of electricity to navigation, and stated the result of recent experiments in accumulator launches. Regarding the future of these vessels, he said it was not expected by the most sanguine that they would ever supersede steam, even on a small scale, but they certainly would obtain a footing for pleasure purposes, where the utter absence of noise, smell, and soot was a great advantage that users were willing to pay for, even though the cost was more than it was now. It was not likely that they would come into general use except for ferry or coast traffic, where the charging plant could be kept at the terminus quay and applied as required.

Ribbon Wire for Dynamos.—We are requested to state that ribbon wire for coils of dynamos, motors, &c., similar to that mentioned in our last, has been manufactured and covered by Messrs Walter T. Glover and Co., and other firms for many years past.

Overhead Electric Light Wires.—Mr. W. H. Rawle, reporting in a suit by the Board of Trade of Philadelphia against the Brush Electric Light Company, stated that there are strung upon the company's poles 55 miles of wire, of which 15 are used by the city for public lighting and 40 for private use. The poles and wires are component parts of the apparatus used for producing the electric light, whose benefit to the general public he dwells on at length. He finds that the wires are not a source of danger to travellers on the highway by reason of the electric current with which they are charged, nor do they increase the risk to property in the event of fire, although he admits that if all overhead wires were removed, easier access could be had by ladders to burning buildings. He further finds that no satisfactory proof has been made that the underground system has as yet been found to be so effective as to supersede the present mode of overhead lighting.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

United Telephone Company, Limited.—At an extraordinary general meeting of the shareholders in this company, held at the offices of the company, Oxford Court, Cannon Street, on the 10th ult, the following special resolution was duly passed and at a subsequent extraordinary general meeting held at the same place on the 31st ult., was confirmed:—"That the Bill which has been introduced into Parliament in the present session, intituled 'A Bill to afford to the United Telephone Company, Limited, additional facilities for telegraphic communication in the Metropolis, and for other purposes,' is approved, subject to such additions, alterations and variations as Parliament may think fit to make therein." The resolution was duly filed on the 1st inst.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of March was 4,116, estimated to produce £3,500, against 3,852 messages, producing £3,296 in the corresponding month of last year. The receipts for the month of December, estimated at £2,500, realised £2,553.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st March, are £3,838, as compared with £3,543 in the corresponding period of 1884.

The Great Northern Telegraph Company. The receipts for March, 1885, £23,200; from January 1st to March 31st, 1885, £64,400; for the corresponding months of 1884, £60,600; and for 1883, £57,200.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending March 31st were £4,390.

PROCEEDINGS OF SOCIETIES.

Physical Society, March 28th.

Prof. GUTHRIE, President, in the Chair.

The PRESIDENT announced that the meeting on May 9th would be held at Bristol; further particulars would be communicated to the members. Mr. Hawes was elected a member of the society. The following papers were read:—"On Calculating Machines," by Mr. JOSEPH EDMONDSON. Calculating machines are of two classes, the automatic and the semi-automatic. The former were invented by Mr. Charles Babbage between 1820 and 1834, and were designed mainly for the computation of tables. The difficulties against which this inventor contended, and the perseverance he displayed in the construction of part of the "difference engine," he had imagined, are now a matter of history. On account of the great cost and high degree of complexity of this machine it was never completed, and the calculating machines of the present day belong to the semi-automatic class, the first example of which is found in a rough and incomplete instrument by Sir Samuel Moreland in 1663. From 1775 to 1780 the Earl of Stanhope invented machines which were a great advance upon those of Sir S. Moreland. In these is found the "stepped reckoner," the basis of all modern instruments. This "stepped reckoner" was improved by M. Thomas de Colmar, who in 1851 produced a machine which is now largely in use. This machine, somewhat improved in detail and construction, is now made by Mr. Tate, of London, and Mr. Edmondson has patented a modification in which the form of the instrument is circular, by which means an endless instead of a limited slide is obtained. A collection of various valuable instruments, which had been kindly lent for the occasion, were exhibited.

A discussion followed, in which General Babbage, Mr. Tate, Prof. M'Leod, Dr. Stone, the Rev. Prof. Harley, Mr. Whipple, Prof. Ayrton, and other gentlemen took part.

"On the Structure of Mechanical Models illustrating some Properties in the Ether," by Prof. G. F. FITZGERALD. The author had recently constructed and described before the Royal Society of Dublin a model illustrating certain properties of the ether. (*Nature*, March 26th.) This model was one-dimensional, but the author now showed how a tri-dimensional model might be imagined, though probably mechanical difficulties would render its actual construction impossible. Each element of the ether is to be represented by a cube on each edge of which there is a paddle-wheel. Thus on any face of the cube there will be four paddle-wheels. Now if any opposite pair of these rotate by different amounts they will tend to pump any liquid in which the whole is immersed into or out of the cube, and if the sides of the cube be elastic, there will be a stress which will tend to stop this differential rotation of the wheels. If, however, the other pair rotate by different amounts, they may undo what the first pair do, and thus the stress will depend on the difference between the differential rotations of these opposite pairs of wheels. If η represent the angular rotation of one pair, and ξ that of the other, the stress will depend upon $\frac{d\,\eta}{d\,x} - \frac{d\,\xi}{d\,y}$. In order that these four wheels may not similarly work with any other wheel, it is necessary to place diaphragms dividing the cube into six cells, each a pyramid standing on a face of the cube. They must be so made that liquid may not be able to pass from one cell to another through the diaphragm or beside the paddle-wheels; to effect this the floats on the paddle-wheels would have to be drawn down while passing the diaphragms. Thus the energy of distorsion of such a medium would depend upon

$$\left(\frac{d\,\zeta}{d\,y} - \frac{d\,\eta}{d\,z}\right)^2 + \left(\frac{d\,\xi}{d\,z} - \frac{d\,\zeta}{d\,x}\right)^2 + \left(\frac{d\,\eta}{d\,x} - \frac{d\,\xi}{d\,\gamma}\right)^2.$$

And Maxwell has shown that this is also true for the ether. The faces of the cubes should be fitted up with diaphragms past which the paddles should pump liquid, and whose elasticity should be the means of storing electrostatic energy in the medium. The most complicated results follow from supposing the faces of the cubes of which the medium is constructed to have different elasticities. Such a structure represents a crystalline medium, and vibrations would be propagated in it according to laws the same as those regulating the transmission of light in crystalline media. If the cubes were twisted the structure would be like that of quartz or other substances rotating the plane of polarisation. To represent magnetic rotation of the plane of polarisation it would be necessary to introduce some mechanism connecting the ether with matter. The author, in conclusion, insisted upon a view which regards the vibrations constituting light to be of the nature of alterations of structure, and not of displacements executed in a medium possessing the properties of an elastic jelly.

At the close of the meeting the following instruments were exhibited and described in a conversational manner by their makers:—

A chronobarometer and a chronothermometer by Mr. STANLEY. These instruments consisted of clocks regulated by pendulums formed in the first instrument of a mercurial barometer, and in the second of a similar barometer enclosed in a hermetically sealed air chamber, the enclosed barometer thus acting as an air thermometer. Increase of pressure in the one case and of temperature in the other causes the mercury to rise, and thus accelerates the pendulum. By the gain or loss of time the mean pressure or temperature can be calculated for any period.

A heliostat and a galvanometer by Mr. CONRAD W. COOKE. The galvanometer is intended to show the internal current in a cell. The battery plates are in two cells connected by four glass tubes in multiple arc coiled round an astatic needle. The glass work is by Mr. Gimingham.

A spherometer, by Mr. HILGER, was made of aluminium, and combined lightness with rigidity. By an electrical contact the maker asserted that measurements could be made to one-millionth part of an inch.

Colonel MALCOLM exhibited a spectroscope and a binocular field-glass, in which the two eye pieces were separately adjustable, and Dr. WATTS exhibited a simple modification of a quadrant electrometer.

CORRESPONDENCE.

Bourseul's Telephone.

Perhaps Major Barney will be kind enough to inform us whether the description of Bourseul's telephone, as detailed in *L'Illustration* of 30th July, 1854, Paris (see his letter in REVIEW of March 1st, 1884), was published in Great Britain at that time or prior to December 9th, 1876? I ask for this information because the description of Bourseul's telephone in *Du Moncel's Exposé*, &c., quoted in his letter in REVIEW of 4th inst., differs materially from the former publication.

Inquirer.

On a Peculiar Behaviour of Glow Lamps when Raised to High Incandescence.

Perhaps you will allow me to make a few remarks on the observations of Mr. Preece regarding the above subject.

The blue glow observed between the platinum supports of the filament when raised to high incandescence, and the diffused glow that pervades the whole globe, are, I think, greatly due to the quality of the carbon filament and the degree of the vacuum obtained, and not only to the high incandescence of the lamp. If the vacuum is of such a degree as to be of very great resistance between the platinum supports of the filament so as to lessen the possibility of a shunt across *a c* or *a e* in fig. 1 of Mr. Preece's article, and the carbon filament is sufficiently hard and has not been previously heated in a hydro-carbon gas, the diffused blue effects can be entirely overcome, even if the nominal candle-power be raised sevenfold.

To show that the diffused blue effects between the platinum supports of the filament or the blue glow that pervades the whole globe when raised to a high degree of incandescence can be gradually lessened and at length entirely overcome, suppose a lamp is exhausted to a certain degree and raised to a high temperature, the blue effects mentioned above will appear. By continuing the exhaustion while the current is still passing through the filament, the blue effects will become intermittent until at length they entirely disappear. By further increasing the incandescence the blue effects will reappear for a short time, and at length they will again become intermittent and again disappear as before. If the exhaustion be continued for some minutes and the lamp hermetically sealed, it may then be raised to the highest incandescence without any blue effects being observable. Also, these effects may be produced by an alternating current as well as by a direct one. Neither is it necessary to have the distance between the electrodes increased any further than is required for what are now known as low resistance lamps in order to prevent an arc forming across the terminals, as lamps are now made requiring 150 to 200 volts, in which the distance between the terminals is not greater than in 45-volt lamps.

Probably the time is not far distant when lamps which are at present reckoned as *high resistance* will be reckoned as *low resistance lamps*.

John B. Duncan.

Alexandra Electric Light Works,
Gateshead-on-Tyne,
April 4th, 1885.

Incandescent Lamp Holders.

Mr. Farquharson's remarks on Mr. Jamieson's paper *re* ship lighting in the current number of the REVIEW throw a good deal of light on what has been until recently a very neglected subject, viz., lamp holders, in the tables as to the *Malabar*. One table shows the loss of lamps under the head of "plaster softened," or in other words, "defective holders," as being 119 out of a total of 316, or, deducting 67 accidental breakages, 119 out of 249, being nearly 50 per cent.

In the other table 75 out of a nett loss of 131, or nearly 60 per cent, leaving out breakages.

One peculiar feature of the tables appears to me to be that the lamps that were most constantly burning suffered least from "softened plaster." It would appear that the heating due to bad contacts had something to do with keeping the plaster dry; thereby turning a palpable evil into an ultimate good, though, of course, at some loss of economy.

It was from the constant recurrence of the loss of lamps through defective fittings that I came to design the holder for the Law Courts which you so kindly noticed this week. It is only during the lull in the battle of dynamos and lamps that the small accessories are noticed; the recent correspondence in the columns of our electrical papers on this subject appears to be bearing good fruit.

A. Grundy,
Electrician,

Royal Courts of Justice,
April 1*st,* 1885.

Dynamo Winding.

In answer to Captain Cardew's further remarks on this subject I beg to say that the whole purport of my first paper was to prove that there was but "one" solution of the problem of converting a dynamo from series to shunt wound, when the same external and internal work and the same speed were maintained.

I would also add that the solution of a quadratic equation is not involved in any part of the calculations.

W. Moon.

6*th April,* 1885.

The Edison Street Mains.

Can you or any of your readers inform me what is the exact nature of the bituminous composition that is employed as an insulating medium in the Edison street mains, and also at what temperature it melts?

S.

April 2*nd,* 1885.

Information Required.

Could any of your readers inform me who manufactures in England:—1. Holmes and Burke's battery? 2. Barnett's accumulators? The foregoing information is required by one of my foreign correspondents.

J. A. Berly.

London, *March* 7*th,* 1885.

The Invention of the Magneto-Telephone.

The small book from which I gave the extract in my letter in the REVIEW of April 4th bears the title "L'Electricité," written by J. Baille, published in Paris and London in 1868 by Hachette. Several editions have been published by the same publishers. A translation into English was published in 1871 by Scribner & Co. in New York and Boston.

In connection with this book I make a few comments referring to my letters in the REVIEW of December 23rd, 1884, respectively headed "*The first inventor of the telephone,*" and "*The invention of the telephone.*"

In the former I gave a list of claimants to the honour of that invention, as follows:—

1. Antonio Meucci, an Italian residing in New York	1849
2. Charles Bourseul, a soldier in French army, 30th July	1854
3. Philipp Reis, Frankfort-on-Main ...	1861
4. Manzetti, of Aorta, Italy	1865
5. Daniel Drawbaugh, United States ...	1866
6. James Mc'Donough, United States, April 4th	1876
7. A. G. Bell, United States, Dec. 9th ...	1876

Subsequent researches justify me to make the following corrections in the list:—

After Drawbaugh comes J. Baille, of Paris, 1868; and next in order is Peter H. Van der Weyde, of New York, 1869.

Among these claimants it is evident that Bourseul is the inventor who first described a magneto-telephone; that description can be found in the REVIEW, March 1st, 1883, page 157, translated from *L'Illustration*, a French publication of 30th July, 1854. This was a magneto-telephone purely and simply, being an electro-magnet with a flexible metal disc.

The second actual inventor of a magneto-telephone is J. Baille, 1868, and the third inventor is Peter H. Van der Weyde, in January, 1869, who exhibited a magneto-telephone and lectured on it at the Cooper Institute in New York in January, 1869. A drawing of Van der Weyde's magneto-telephone can be found in the REVIEW of November 1st, 1884, page 345. I may add that I have in my possession several photographs taken from these identical instruments.

In conclusion, I refer to a letter by me in the REVIEW, February 23rd, 1884, pages 163-64, wherein I proved by Bell himself that he had full knowledge of Reis's invention, and therefore that he was not an inventor of the telephone but merely an *improver* of Reis's telephone. Mr. Bell in his lecture before the Society of Telegraph Engineers, October 31st, 1877, gave the names of the authors he had consulted prior to making his telephone, and in that list is found Du Moncel's "Exposé," vol. 3, page 83, where is found Bourseul's description of a magneto-telephone which, in fact, is a more complete description of Bell's telephone than the description of it in Bell's patent.

Is it credible that Bell did not know of Baille's telephone in face of the fact that the book "Wonders of Electricity" was published in Boston in 1871, where Bell resided? *Credat Judæus!*

Did not Bourseul in 1854, and Baille in 1868, describe a magneto-telephone in more precise terms than Bell's description in his patents or lectures in 1876? Can any impartial person give to Bell the credit of being *even an improver* of Reis's telephone? Do not the publications above named establish the fact that the magneto-telephone was well known years before the date of Bell's claim, and consequently that Bell was not the inventor thereof, and that Bourseul-Baille's magneto-telephone is identical with that described and claimed by Bell in his patent? "*Audaces fortuna juvat.*"

W. C. Barney.

April 6*th,* 1885.

[The work by Baille mentioned may be found at the British Museum, the "Press Mark" being "8755 *a a a*," and the place and date of publication, Paris, 1868.—EDS. ELEC. REV.]

Disclaimer under the Patents, Designs, and Trade Marks Act, 1883.

Under this Act the effect upon the rights of the patentee and of the public are very greatly changed from those drastic effects under the old patent law.

Under the old law, where it became necessary to disclaim any portion of a patent to save the patent, the rights of the patentee became in abeyance, and the public had a right to make, use, and sell, and to contract *bonâ fide* to make instruments as described in the patent, until the fiat of the Law Office should be obtained and duly filed at the Patent Office. This bore severely on the patentee; but the 20th section of the new Act says:—"No damages shall be given in any action in respect of the use of the invention before the disclaimer." This I take to mean that instruments in actual *use* only are exempt; not those which may have been made or contracted for in good faith.

This section is one of the most beneficial to the inventor, and at the same time it is not prejudicial to the public at large; but it will prevent manufacturers (harpies and hyeuas) from profiting from an error in the patent by making quantities of the patented article, to the injury of the honest patentee.

W. C. Barney.

April 6*th,* 1885.

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